

JACK BINNS' **RADIO** DEPARTMENT

# Popular Science

FOUNDED **MONTHLY** 1872



Read How to Down the Demons of Waste and Double the Life of Your Car  
**How to Heat Your Home with 30 Per Cent Less Coal**

CTOBER

*Useful Designs for Mechanics and Tool Users*

25 CENTS

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# Cunningham tubes

The Heart of  
Your Home Receiving Set

**AMPLIFIES AS  
IT DETECTS**

*—enjoy clear reception by  
using Cunningham Tubes*



**TYPE C-300  
GAS CONTENT  
DETECTOR  
\$5.00**

**TYPE C-301  
HIGH VACUUM  
AMPLIFIER  
\$6.50**

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Cunningham tubes  
are covered by pat-  
ents dated 11-7-06,  
1-16-07, 9-18-08 and  
others issued and  
pending. Licensed  
only for amateur or  
experimental use in  
radio communication.  
Any other use will  
be an infringement.

Cunningham Detector Tube, type C-300, insures clearest recep-  
tion for all radio messages, concerts, press and weather reports.

The rigid specifications to which these tubes are built in the  
General Electric Laboratories determine their uniform opera-  
tion and perfect clearness.

Cunningham Amplifying Tube, type C-301, is conceded to be  
the most efficient amplifier ever produced. For complex and  
multi-stage circuits, freedom from dis-  
tortion and absence of all tube noises as  
well as for the operation of loud speaking  
telephones and devices requiring consider-  
able power, this tube has no equal.

If your dealer cannot supply you, write us  
direct for the name of a Radio Dealer  
who can.



The trade mark GE  
is the guarantee of  
these quality tubes.  
Each tube is care-  
fully inspected and  
tested before leaving  
the G. E. factory.

*A. J. Cunningham*

248 First Street  
San Francisco, Calif.

Trading as  
**AUDIOTRON MFG. COMPANY**

154 West Lake Street  
Chicago, Illinois



# NOW FREE!

## The Book That Has Shown Thousands The Way To Amazing Salary Increases.



**D**O you want to leave the rut of routine work for a position that will grow daily in its fascination? Do you want to start right out making more money than you ever dreamed possible? We have done exactly this for thousands of men. Here is the book which gave them their start. Read how it is now offered to you—FREE!

**T**AKE this situation. A man who had worked all his life in a routine job at low pay suddenly surprises his friends by moving into a better neighborhood, taking a big house, buying a car and blossoming out as a well-to-do and influential citizen in his new community. How did he do it? What is the secret that he used? Simple enough. He knew that the biggest money in business is in Selling, and though he felt that he couldn't sell a thing, he suddenly learned the secrets that make Master Salesmen and then began to make big money.

If only one man had found inspiration enough in this remarkable book to jump to a sudden brilliant success in the Selling field—into a job paying him many times his former salary—then you might call it luck. But thousands have done it.

### Your One Chance to Make the Biggest Money of Your Life

Not one of the men whose names appear below had ever sold a thing before—not a dime's worth. If you

had told one of them that he could sell he would have laughed at you. Probably he would have come back with the old saw, "Salesmen are born, not made." They were frankly skeptical. Yet every one of these men, through reading this book, discovered the fallacy of this vicious old idea that Salesmen are "born." They learned that *Master Salesmen are made!* And in this book they found an amazingly easy way to jump suddenly from low pay to extraordinary earnings.

### Simple as A B C

Sounds remarkable doesn't it. Yet there is nothing remarkable about it. There are certain ways to approach different types of prospects to get their undivided attention—certain ways to stimulate keen interest—certain ways to overcome objections, batter down prejudices, outwit competition and make the prospect act.

If you will learn these principles there is awaiting you a brilliant success and more money than you ever dreamed of earning. This book, "Modern Salesmanship" tells exactly how the National Salesmen's Training Association will make you a Master Salesman.

As soon as you are qualified and ready the Employment Service of the National Salesmen's Training Association will help you to select and secure a selling position as city or traveling salesman. Thousands of the biggest, most reputable selling organizations in America turn to this Association for their Star Salesmen.

### Now Free to Every Man Who Will Act At Once

We are not making any extravagant claims about what we will do for you. We don't have to. The records of the truly amazing successes for which we are responsible are so overwhelming a testimonial of the fact that any man of average intelligence can become a Master Salesman that we are willing to leave the decision entirely up to you. All of this amazing proof and many important features about Salesmanship are contained

in our salary raising book, "Modern Salesmanship." It is yours—FREE. Send the coupon for it today. It will show you how you can quickly become a Master Salesman—a big money maker. It will tell you about the National Salesmen's Training Association system of Salesmanship training that has meant prosperity to so many thousands of men—about the National Demonstration method that gives you actual experience while studying—and all about the amazing opportunities that await you in the selling field.

If you do not send this coupon we will lose merely the opportunity to train one more Master Salesman. But for you, failure to act may mean that you lose the one big chance of your life to leave forever behind you the low pay of a routine job. It may mean the difference between this and a sudden, brilliant success at a big salary. Is it worth 2c to find out? Then mail this coupon NOW.

### NATIONAL SALESMEN'S TRAINING ASSOCIATION

Dept. 15-R

Chicago, Illinois

National Salesmen's Training Association

Dept. 15-R, Chicago, Ill.

I simply want to see the facts. Send me FREE your book "Modern Salesmanship" and prove that I can become a Master Salesman. Also tell how you can help me to a position and send list of lines with openings for Salesmen.

Name.....

Address.....

City.....State.....

Age.....Occupation.....

### Read

Charles Berry of Winterset, Iowa, stepped from \$18 a week as a clerk to a position making him \$1,000 the very first month. J. P. Overstreet of Deamston, Texas, read this amazing book, left a job on the Capitol Police Force at a salary of less than \$1,000 a year and in six weeks earned \$1,800. F. Wynn, Portland, Ore., an ex-service man, earned \$554.37 in one week. Geo. W. Kearns of Oklahoma City found in this book a way to jump his earnings from \$60 a month to \$524.00 in two weeks and C. W. Campbell learned from it how he could quit a clerking job on the railroad to earn \$1,032 in thirty days.



# POPULAR SCIENCE MONTHLY

OCTOBER, 1922; Vol. 101, No. 4  
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Published in New York City at  
 225 West Thirty-ninth Street

## How to Double Your Car's Life

**E**VERYBODY in America wants an automobile. It is less dangerous to make that generalization about the universal desire for a car than about almost any other semi-luxury. With over ten million automobiles in use, there are still more people that want cars of their own.

**A**STONISHING price cuts in cars, this year, together with easy purchase plans, have put it within the power of thousands to buy something that runs on wheels. But fear of upkeep costs deters them from the purchase. And to ten million Americans who are already automobile owners the upkeep is also an exasperating factor of daily existence.

**N**OW, it costs the average American altogether too much to run his car. It is equally true that many a man who hesitates to buy because of upkeep costs would stop hesitating if he realized how these costs can be halved by careful attention to the car, backed by knowledge of its needs.

**H**OW to get more pleasure out of your car at less cost is made plain in a remarkable series of articles now appearing in POPULAR SCIENCE MONTHLY. The unseen demons of waste, pictured on our cover this month, cause the average owner of a low priced car something like \$600 in needless expense. Know your car, learn how to take care of it, and you can save this wasted money. Many a man might actually double his car's life by downing these waste demons.

**T**HE article by Harold F. Blanchard, on page 68 of this issue, his article on "Tuning Up the Car," appearing next month, and his article to appear in the December issue, telling how to save from 20 to 80 per cent in gasoline costs by proper carburetor adjustment, will be invaluable to the automobile owner and the prospective automobile purchaser.

## More Heat from Less Coal

**T**HE problem of getting enough coal for this winter is vital in nearly every house in the land today. Whatever efforts are made to increase coal production this fall, it seems inevitable that we shall have to get along on short fuel rations. Coal economy becomes, therefore, a matter not only of money saving, but of actual physical comfort.

**T**HE article on page 80 of this issue, written by one of the most successful heating engineers in the country, points out simple methods by which the average home owner can get more heat with less fuel. The results of important scientific research in heating problems, that are of the most intense interest to every reader, are here published for the first time outside of technical circles.

**M**AKING a small coal pile last longer, and getting more heat at less cost not only this year, but every year henceforward, will be easy for almost any man who is willing to use a few tools to make improvements in his home. Very few medium-priced houses are built as they should be to insure really efficient heating.

**A**N INFORMATIVE article on this topic with new drawings, to appear in the Home Workshop Department next month, will be of the most practical assistance to every householder.

**D**ON'T miss Jack Binns' "Ten Commandments for Radio Users!" Beginning in the November issue, this feature will unquestionably be voted the most valuable radio material we have yet published. In this new series of articles, America's most popular writer on wireless topics gives simple advice for operating with the maximum efficiency the most commonly used types of radio receiving apparatus. With his help you will get better results from your radio set.

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And 84 Important News Articles

**THE HOME WORKSHOP**  
*Half a Hundred New Ideas for Tool  
 Users, pages 73-120*

\$75 in Prizes—See pages 91 and 103

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 POPULAR SCIENCE MONTHLY

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 The contents of this magazine are copyrighted and must not be  
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 Vice-President; O. B. Capen, Secretary and Treasurer.



# Do *YOU* Do Any of These Embarrassing Things?



The man in this picture has reason to be ill at ease. He has attended an informal dinner in conventional full dress. The Book of Etiquette would have told him how to interpret the word "informal" on the invitation—and would have revealed to him important things to know regarding an informal social function. The Book of Etiquette tells you what to wear on all occasions.



His friend has just introduced him to the young woman. Instead of waiting for her to offer her hand and make the acknowledgment, he has extended his hand first and mumbled confusedly something about being "Glad to meet you." By telling you how to make and acknowledge introductions, the Book of Etiquette prevents a great many embarrassing blunders.



She has just signed her name in the hotel register, and glanced at the names above. She sees, in these other signatures, that she has made a mistake—that she has registered incorrectly. Mistakes such as these can often be very embarrassing indeed. The Book of Etiquette prevents them, as it covers the whole subject of hotel etiquette completely and authoritatively.



Without realizing his mistake, the man in this picture has followed the head waiter, preceding the young woman. It is the wrong order of precedence, and he discovers it to his embarrassment only when he notices the entrance of another couple. The Book of Etiquette tells you about the mistakes that might be made, when entering the theatre, the street car, the drawing room. And it tells you how to avoid these humiliating blunders.



Every one knows that table manners are an index to breeding. The man in this picture has taken olives with a fork, and has just realized his error, as the others have taken them with their fingers. Too bad he didn't refer to his Book of Etiquette! It tells all about table manners—how to eat corn on the cob, lettuce, asparagus, frozen pudding.



The gentleman at the right does not know how to dance. Instead of doing what he should, under the circumstances, he is making himself conspicuous by standing alone while the others dance. The Book of Etiquette would have told him how to avoid this embarrassment—and would have told him also the complete etiquette of the dance and of dancing. It is a most fascinating chapter.

## The Book of Etiquette Sent for FREE Examination

If you do not already own the famous two-volume set of the Book of Etiquette, send for a set at once that you may examine it at our expense. Don't be without it another week. It solves many little problems that may be puzzling you, tells you the right thing to do, say, write and wear on all occasions.

It costs you nothing to examine the Book of Etiquette. You are not obligated to keep the set if you are not delighted with it. You be the judge—just mail the coupon and let us send you the Book of Etiquette for free examination. But do it NOW!

NELSON DOUBLEDAY, Inc., Dept. 2510, Oyster Bay, N. Y.

NELSON DOUBLEDAY, Inc., Dept. 2510, Oyster Bay, N. Y.

I accept your free examination offer. You may send me the two-volume set of the Book of Etiquette for 5 days. During that time I will examine the books, read some of the chapters, examine the illustrations. I understand that all phases of etiquette are covered—wedding etiquette; the etiquette of dress, of speech, of manners; dance, party, tea etiquette, etc. Within this 5 day free period I will either return the books or keep them as my own and send you only \$5.50 in full payment. I need not keep the set unless I am delighted with it.

Name.....

Address.....

City..... State.....

☐ Check in this square if you want these books with the beautiful full leather binding at \$5.00, with 5 days' examination privilege.



# QUICK-ACTION ADVERTISING

HERE READERS AND ADVERTISERS MEET TO TRANSACT BUSINESS

Rate 25 Cents a Word. Advertisements intended for the December issue should be received by October 1st

## AUTOMOBILES AND ACCESSORIES

**PATENTS**—Write for free Illustrated Guide Book and Evidence of Concealment Blank. Send model or sketch and description of invention for our opinion of its patentable nature. Highest reference. Reasonable terms. Victor J. Evans & Company, 189 Ninth, Washington, D. C.

**AMERICAN Garage & Auto Dealer** publishes each month interesting and helpful suggestions and information on sales, merchandising, advertising, business management, accounting, waiting, routing, training, practical and progressive hints for office and shop, for "small-town" automotive dealers, garages, repairmen, mechanics, subscription price \$1.00 per year. (Money back if not satisfied.) Sample copy on request. American Garage & Auto Dealer, 1030 Lake View Building, Chicago.

**PROTECTION** from the Wind, Dust, Rain and Snow—Use "Wear Me" Windshield Wiper and motor with pleasure. Fully Guaranteed. Money back if not satisfied after ten days use. Regular Set \$15.00, Ford Special \$10.00. Wear Me Auto Specialty Company, 1602 Broadway, Pittsburgh, Pennsylvania. See "Ad" page 104.

**FREE** sample, Tupper Liquid Auto Glass. Easily applied. Drives quickly giving rich lustrous finish. New life to the old paint. Rosenthal Chemical Co., Forest, Mont.

**AUTOMOBILE Mechanics, Owners, Garagesmen, Repairsmen**, send for free copy America's Popular Motor Magazine. Contains helpful instructive information on overhauling, ignition wiring, carburetors, batteries, etc. Automobile Digest, 513 Butler Building, Cincinnati, Ohio.

**MR. ADVERTISER**, Ask to-day for a copy of the "Quick-Action Advertising Rate Folder." It contains some really important facts which will prove interesting and valuable to you. It also tells "How You Can Use Popular Science Monthly Profitably." You'd like to know, wouldn't you? Manager Classified Advertising, Popular Science Monthly, 225 West 39th Street, New York.

## FORD ACCESSORIES

**CYCLE "Dynamite"** promises remarkable solution of hot-spot problem. Cycle Manufacturing Co., Chestnut St., Akron, Ohio.

**LIFE** also "red-hot" surest patterns with simple illustrated instructions make Ford sport car building easy. The fast easy "Pat" pattern with pressed metal streamline rear only \$0.40 complete and delivered. Send for prospectus on making sport bodies—Jiffy Type—Gosum Windshields, Kumpel Co., 90 Kumpel Bldg., Ottumwa, Iowa.

## ELECTRICAL

**ELECTRICITY** for 10¢ per hour. Motion auto generator. Operates on any make automobile. Produces electricity for moving picture machines, theatres, schools, churches, homes, etc. Write for free particulars. Monarch Theatre Supply Co., Dept. AD 724 South Wabash Avenue, Chicago.

## WANTED

**DETECTIVES**—Excellent opportunity. Fascinating work. Experience unnecessary. Particulars free. Write American Detective System, 1918 Broadway, New York.

**CASH** for old gold, platinum, silver, diamonds, Liberty Bonds, War, Thrift, unpaid postage stamps, false teeth, Magenta Points, Japs, and valuables. Mail in today. Cash sent, return mail. Goods returned in ten days if you're not satisfied. Ohio Smelting Co., 309 Hippodrome Bldg., Cleveland, Ohio.

**WANTED**—Representatives in every factory in the United States. Popular Science Monthly, 225 West 39th Street, New York.

**MR. ADVERTISER**, Ask to-day for a copy of the "Quick-Action Advertising Rate Folder." It contains some really important facts which will prove interesting and valuable to you. It also tells "How You Can Use Popular Science Monthly Profitably." You'd like to know, wouldn't you? Manager Classified Advertising, Popular Science Monthly, 225 West 39th Street, New York.

## DUPLICATING SERVICES

**"MODERN"** Duplicators save Time, Labor and Money. Copy Business, Reproduction Typewritten or Printed Letters, Drawings, Letters, Maps, Memos, Bills, Notices, Specifications, Maps or anything in one or more colors. Prints TWO per minute. Special Rate Co., 30 Days Free Trial, \$2.25 up. Booklet Free. J. V. Durkin-Reeves Co., Pittsburgh, Pennsylvania.

## TRAIN SCHOOLS

**DENTAL** laboratory work quickly taught through individual instruction. Our graduates in great demand, earn \$1600 to \$6600 yearly. Earn while you learn. Send for Bulletin 4 McCurtis School of Mechanical Dentistry, 34 West Lake Street, Chicago.

**EARN** more money—Learn sign painting, scenic painting, shorthand writing, auto painting, paper hanging, decorating, painting, marbling, in Chicago or at your home. Chicago Painting School, 157 West Audin Avenue, Chicago.

## LABORATORY AND CHEMICAL SERVICE

**YOUR** problem solved for Five Dollars. Write me, W. Steelman Richards, Consulting Chemist, Box 2492, Boston, Massachusetts.

## TELEGRAPHY

**TELEGRAPHY**—Office and railway and wireless telegraphing thoroughly. Big salaries, great opportunities. Oldest, largest school. All expenses low—can earn large part. Catalogue free. Dodge's Institute, Queen Street, Valparaiso, Indiana.

## BOATS AND LAUNCHES

**16-FOOT** runabout. Easily made. Construction blueprint, 30¢. Wee-Shu-U Co., 41-8 West Market, Detroit, Michigan.

## MANUFACTURING

**WE** manufacture anything, design and build special machinery, develop inventions, build models, make drawings of every description, our facilities the best. Write for booklet. R. G. Cline Engineering Co., 84, Louis, Missouri.

**LET** us manufacture that part or article for you. Victor Engineering Co., 2521 W. Chicago Avenue, Chicago, Illinois.

**TO** Order Metal Articles, models, tools, patterns, experimenting, manufacturing, inventions developed. Cleveland Specialty & Manufacturing Co., Seaside Avenue, Cleveland, Ohio.

## ADDING MACHINES

**FREE** trial, marvelous new adding machine. Adds, subtracts, multiplies, divides automatically. Work equals \$250.00 machine. Price only \$15.00. Speedy, durable, handsome. Five-year guarantee. Used by largest corporations. Write to-day for catalog and free trial offer. Lightning Calculator Co., Dept. C, Grand Rapids, Mich.

## Here's Proof Positive of Good Results

When an advertiser uses one insertion in a magazine—or even two—and then stops, it is natural to assume that the investment wasn't a paying one. But when a well established mail-order concern keeps using space month after month, year after year, without omission, it is proof positive of good results. For such an advertiser invariably keeps a careful record of returns and if it didn't pay, they wouldn't stay. Here's what we mean!

Popular Science Monthly,  
New York City.

Gentlemen:

Your magazine has always proved a favorable medium. It places us in contact with persons of general intelligence, who mean business and who have the means to carry out their ambitions.

The fact that we long ago authorized our advertising agency to carry our account with you on a "c. f." basis is proof of the high estimation in which we regard your magazine.

Yours truly,

National Literary & Publishers'  
Service Bureau.

Why don't YOU try the next issue? At 25 cents a word, with a circulation of over a quarter of a million, you cannot afford to ignore this market. Just drop us a line and we'll give you the facts. Thank you.

Classified Advertising Manager  
POPULAR SCIENCE MONTHLY  
225 West 39th Street  
New York City

## FORMULAS

**FREE**—Formula catalog. Laboratories, 6800 Boylston Building, Chicago.

**3000 FORMULAS** and recipes—600 pages. \$1.00. Englewood Book Shop, 7021D South Winchester, Chicago.

**FORMULA** catalog free. C. A. Latz, Apartment 341, York, Pennsylvania.

**FORMULAS** of the better sort. Write for our free catalog. Thor. Steel, President, 622 Main, Richmond, Virginia.

**1,000,000** formulas, trade secrets, processes. \$2.00. 247-Hershey, 98402, Kokomo, Indiana.

## RADIO SUPPLIES

**WONDERFUL** Invaluable Crystal Radio Set. Complete with Head Phone and Duroc Plug. Fits any electric socket. No outside antenna necessary. \$20.00. Popular Science Monthly, 225 West 39th Street, New York.

**WESTINGHOUSE** and other standard radio sets and parts. Liberal commissions paid for interesting offers which enable you easily to earn your set and make money. Write for price list and proposition. Wheeler-Thomas Radio Co., Dept. 28, Holland, New York.

**MR. ADVERTISER**, Ask to-day for a copy of the "Quick-Action Advertising Rate Folder." It contains some really important facts which will prove interesting and valuable to you. It also tells "How You Can Use Popular Science Monthly Profitably." You'd like to know, wouldn't you? Manager Classified Advertising, Popular Science Monthly, 225 West 39th Street, New York.

## MOTORCYCLES, BICYCLES, SUPPLIES

**DON'T** buy a bicycle motor attachment until you get our catalogue and prices. Shaw Mfg. Co., Dept. 4, Galena, Kansas.

**PARTS** for all motorcycles cheap. Schunk Cycle Co., 1872 Westlake, Seattle, Washington.

**USED** and new parts. Indian, Excelsior, Harley, Reading, Thor, Henderson, Yale. Get our price lists. Kings Highway Cycle Co., 1180 North Kings Highway, St. Louis, Missouri.

**LARGEST** stock of new and used motorcycle parts and accessories in the world at your disposal via Uncle Sam's mail. Write for quotations. Motorcycle Parts Mfg. Co., 3030-34 Wabash Avenue, Chicago, Illinois.

## STAMPING NAMES

**MAKE** \$10.00 hundred stamping names on key chains. Send 25¢ for sample and instruction. Pe Keytag Company, Cohoes, New York.

## AMERICAN MADE TOYS

**INCREASE** your output of metal toys and novelties by using a casting form hand machine. Write for circular T-4. V. G. Crote, Mechanicville, New York.

## AVIATION

**PROPELLERS** for airplane propulsion, small propellers for motorcycle driven motor and ice sleds, road speedsters, and hydroplanes, 5 foot diam. \$12, 6 foot diam. for Ford \$15, others in proportion, hub mountings, bearings, sprockets, and counterweights complete, full scale blue prints for building motorcycle models etc. Ford type \$1.00. Crawford Motor and Airplane Manufacturer, Longbeach, California.

**INVENTORS** desiring information write for our free Illustrated Guide Book and Evidence of Concealment Blank. Send model or sketch of invention for our opinion of its patentable nature. Highest reference. Prompt service. Reasonable terms. Victor J. Evans & Company, 161 Ninth, Washington, D. C.

## MODELS AND MODEL SUPPLIES

**WE** make working models for inventors and experimental work, and carry a complete stock of brass gears and model supplies. Send for catalogue. The Pierce Model Works, Tinsley Park, Illinois.

**MODEL** making and experimental work; modern shop, expert workmen. Manufacturing, Lawson Model and Experimental Works, 825 W. Jackson, Chicago.

## FOR THE HOME

**ORDINARY** door locks made absolutely burglar-proof by simple device. Set for three doors \$1.00. H. Gruesbeck, 230 Fourth Ave., Salt Lake, Utah.

**HOME** Builders Guide, 36 home plans price \$1. L. Bostad, Architect, 4 Palladio Building, Duluth, Minnesota.

**GRANDFATHER** clock works, \$5.00. Build your own case, instructions free, make good profits selling your friends. Clock works with chains for old or new cases. Write for full particulars. Clock Co., Niles, Pennsylvania.

## FOR BOYS

**MOUTH-ORGAN** instructor, 25¢. Play in one hour. Kloss Publisher, Bowling Green, Ohio.

## ASTROLOGY

**MAGIC** words! Secret, sure method of obtaining your desires. Postpaid for dime. Smedley, 146 Miller, Brooklyn, N. Y.

**ASTROLOGY** Reprints, 2000 word trial reading 25¢; ten questions free. State Birthdate, Prof. Audrey, Desk D, Departmental Bank Bldg., Washington, D. C.

## HOROSCOPES

**YOUR** horoscope covering full year, 25¢. Includes extensive reading, valuable daily guide, large pictorial chart and special forecasts for each month. Scientific, complete. Try it! Money back if dissatisfied. Give birthdate. Address: J. Daniels, Flatbush Station, Box 32, Brooklyn, New York.

**YOUR** horoscope, business, changes, social, matrimonial prospects. Send birthdate and 10 cents stamps for remarkable free reading. Zakra, 202-G, West 104th Street, New York.

## SAFETY RAZORS SHARPENED

**BLADES** resharpened 3¢, any make. Guaranteed service. Standard Safety Razor, Pittsburgh, Pennsylvania.

Quick-Action Advertisements continued on page 6



# BUILDING TRADES NEED TRAINED MEN!



## Thousands of Good Positions at Good Salaries

**T**HE business tide has turned! And the building trades are leading the way back to prosperity!

Building contracts made to July 1 of this year are the largest in number and in value ever awarded in any six months in this country's history. Government experts estimate that more than four billion dollars will be spent for construction this year.

And this is only the beginning of a building campaign that must last for years. There is a shortage of more than a million homes, and half a million more are needed each year to provide for normal growth.

"It will take us 12 years, working 25 per cent above normal," says John Ihlder, Manager of the Civic Development Department of the United States Chamber of Commerce, "to provide as adequately for our population as before the war."

Thousands of schools, churches, hospitals, banks, office buildings, warehouses, grain elevators and public buildings are needed and must be built. Millions of dollars will be spent in the building of roads and bridges.

### Trained men needed

Today the most vital need of this great building program is men—trained men—men who can step right in and do the skilled work that building construction requires. Those needed most are draftsmen, architects, foremen, contractors, structural engineers, concrete engineers, surveyors, mechanical engineers, civil engineers, electricians.

Right now there is a shortage of men in these skilled trades and professions. E. J. Brunner, Editor of the American Contractor, says: "The construction industry is reaching out with a fine-tooth comb for all available skilled mechanics of the building trades."

If this situation exists now, think what it will be six months, a year, two years hence, when other industrial activities are back to capacity and men cannot be drawn from other fields.

Do you realize what this means to you? It means that if you are now employed on construction work, you can, through

special training, qualify for advancement to more important and more responsible work at a greatly increased salary, or prepare to establish yourself in your own business.

It means that if you are now in other work, but would like to get into building construction, you can start immediately. The best plan is to take up the study of that branch of building which interests you most. Devote your spare time to it. In a surprisingly short while you will have learned to do some one definite kind of work that most men cannot do at all. And in almost every community you will find builders or contractors or architects who will be glad to pay you well for doing that special work for them.

There is a simple, easy, fascinating way by which you can prepare for a good position, at good salary. You can do it right at home, in spare time, no matter where you live, through the International Correspondence Schools.

There is no question—no doubt about this. For thirty years the I. C. S. has been training men for advancement in the building trades and in more than three hundred other business and technical subjects.

A recent investigation of 13,298 students enrolled in I. C. S. Building Trades Courses showed that

1291 had become Architects  
246 had become Designers  
494 had become Chief Draftsmen  
2827 had become Draftsmen  
1845 had become Contractors  
211 had become Assistant Foremen  
4938 had become Foremen  
3264 had become Superintendents

**I**N every instance these students reported salaries or independent incomes far greater than when they took up their studies. Many have shown increases of 300% to 500%. Some have incomes as high as \$25,000 per year.

The Equitable Building, New York, was erected under the direction of I. C. S. Student H. E. Gardner, then Superintendent of Construction for the Thompson-Starrett Company.

The Classical High School, Lynn, Mass., was built by I. C. S. Student George H. Stone.

The Kansas State Memorial Building, Topeka, was designed and erected by I. C. S. Student C. H. Chandler, then State Architect of Kansas.

The Pacific Building, San Francisco, largest

reinforced concrete building in the world, was built under the direction of I. C. S. Student Erik Holman.

George A. Griebel, who was a stone-mason by trade, decided to win success in construction work and took an I. C. S. Course. Today he is a member of the Griebel Company, Cleveland, earning \$12,000 a year. In one year his firm erected buildings worth \$4,500,000.

These men won success under conditions less favorable than those that surround you today. Now there is a need for skilled men more urgent than the building trades have ever known.

### Your chance has come

You can have the position you want in the work you like best, an income that will give you and your family the home, the comforts, the luxuries you would like them to have. No matter what your age, your occupation, or your means, you can do it!

All we ask is the chance to prove it. That's fair, isn't it? Then mark the work you would like best in the coupon below and mail it today. There is no obligation and not a penny of cost. It takes but a moment, but it is the most important thing you can do today. Do it now!

— — — — — **TEAR OUT HERE** — — — — —  
**INTERNATIONAL CORRESPONDENCE SCHOOLS**  
Box 7005-C, Scranton, Penna.

Without cost or obligation, please send me your 48-page booklet, "Who Wins and Why," and full information about the subject before which I have checked an X in the list below:

TECHNICAL AND INDUSTRIAL DEPARTMENT	
<input type="checkbox"/> Architect	<input type="checkbox"/> Surveying and Mapping
<input type="checkbox"/> Architectural Draftsman	<input type="checkbox"/> Gas Engine Operating
<input type="checkbox"/> Pipe Fitter	<input type="checkbox"/> Automobile Work
<input type="checkbox"/> Building Foreman	<input type="checkbox"/> Airplane Engines
<input type="checkbox"/> Concrete Builder	<input type="checkbox"/> Plumber and Steam Fitter
<input type="checkbox"/> Contractor and Builder	<input type="checkbox"/> Plumbing Inspector
<input type="checkbox"/> Structural Draftsman	<input type="checkbox"/> Foreman Plumber
<input type="checkbox"/> Structural Engineer	<input type="checkbox"/> Heating and Ventilation
<input type="checkbox"/> Electrician	<input type="checkbox"/> Sheet Metal Worker
<input type="checkbox"/> Electrical Engineer	<input type="checkbox"/> Steam Engineer
<input type="checkbox"/> Electrical Contractor	<input type="checkbox"/> Railroad Facilities
<input type="checkbox"/> Electric Wiring	<input type="checkbox"/> Chemistry
<input type="checkbox"/> Mechanical Engineer	<input type="checkbox"/> Pharmacy
<input type="checkbox"/> Mechanical Draftsman	<input type="checkbox"/> Metallurgy
<input type="checkbox"/> Machine Shop Practice	<input type="checkbox"/> Mining Engineer
<input type="checkbox"/> Toolmaker	<input type="checkbox"/> Navigation
<input type="checkbox"/> Civil Engineering	<input type="checkbox"/> Mathematics <input type="checkbox"/> Radio

BUSINESS TRAINING DEPARTMENT	
<input type="checkbox"/> Business Management	<input type="checkbox"/> French
<input type="checkbox"/> Industrial Management	<input type="checkbox"/> Salesmanship
<input type="checkbox"/> Personnel Organization	<input type="checkbox"/> Advertising
<input type="checkbox"/> Traffic Management	<input type="checkbox"/> Better Letters
<input type="checkbox"/> Business Law	<input type="checkbox"/> Foreign Trade
<input type="checkbox"/> Banking and Banking Law	<input type="checkbox"/> Shorthand Lettering
<input type="checkbox"/> Accountancy	<input type="checkbox"/> Stenography and Typing
<input type="checkbox"/> (Including C.P.A.)	<input type="checkbox"/> Teacher
<input type="checkbox"/> Nicholson Cost Accounting	<input type="checkbox"/> Civil Service
<input type="checkbox"/> Bookkeeping	<input type="checkbox"/> Railway Mail Clerk
<input type="checkbox"/> Business English	<input type="checkbox"/> Common School Subjects
<input type="checkbox"/> Private Secretary	<input type="checkbox"/> High School Subjects
<input type="checkbox"/> Business Spanish	<input type="checkbox"/> Illustration
	<input type="checkbox"/> Cartography

Name \_\_\_\_\_  
Street \_\_\_\_\_  
Address \_\_\_\_\_

City \_\_\_\_\_ State \_\_\_\_\_

Occupation \_\_\_\_\_  
Persons residing in Canada should send this coupon to the International Correspondence Schools, Canadian, Limited, Montreal, Canada.





## Which One?

Not one of these jobs is beyond your reach—Which one do you want?

The kind of a fellow who gets ahead today—and holds one of these high positions is the fellow with *training*. Nowadays employers can find men with training very easily, because colleges are graduating them pretty fast—so the fellow who had to leave school early is handicapped unless he gets training during his idle hours.

Today, you can get it in your home town, every man can, regardless of how much time he spent in school. And you can make every hour of your practical experience pay big dividends as well. American School training was made for YOU and has brought success to thousands.

## Big Raise in Salary

It is easy to get, if you go about it in the right way. You have often heard of others who doubled and trebled their salaries in a year's time. You wondered how they did it. Was it a pull? Don't you think it. When a man is hired he gets paid for exactly what he does, there is no sentiment in business. It's preparing for the future and knowing what to do at the right time that doubles and trebles salaries.

## Why Don't You Try It?

Why don't you see what an American School course will do for you? Our experience in helping thousands of others will surely help you get to the top. If you really want to get ahead, get busy and—

## Mail This Coupon Today

Send us your name and address on the coupon. Just write underneath, in the coupon what job you want to hold. We'll tell you how you can get just the training you need right in your own home.

You'll be under no obligation—and the information you will get will do you a great deal of good. Let us help you. We are at your service—and all you need to do is to send this coupon with your name and address. Do it now—for your own sake and the man you want to be.

**American School** Dept. C-775 Chicago, U.S.A.  
Dept. C-775

I want this job—tell me how to get it.

Job .....

Name .....

Address .....

## DO YOU LIKE TO DRAW?

Cartoonists are well paid

We will not give you any credit unless you can draw. We will not give you any credit unless you can draw. We will not give you any credit unless you can draw.

The W. I. EVANS SCHOOL OF CARTOONING  
625 Under Blvd. Cleveland, Ohio



## STAMMER

If you stammer, attend to stammering school and you get for free FREE book entitled "STAMMERING, Its Causes and The Advanced Natural Method of Cure," bound in cloth and stamped in gold. Ask for special catalog and a FREE copy of "The Stammering School." Large, long, equipped and most successful school in the world for the cure of stammering. No waiting or time limit. School open all year. Now is the best time to enroll. Lee Wills Millard, Free, The North-Western School, 235 Canal Ave., Milwaukee, Wis.

## WANTED

**Railway Mail Clerks**  
\$1600 to \$2300 Year

**MEN—BOYS OVER 16**  
SHOULD WRITE IMMEDIATELY  
Steady Work. No Layoffs. Paid Vacations  
Common Education Sufficient  
Send Coupon Today—SURE



FRANKLIN INSTITUTE, Dept. R77, Rochester, N. Y.  
Send me, without charge, (1) Sample Railway Mail Clerk Examination questions; (2) Schedule showing places to sit coming U. S. Government examinations; (3) List of many government jobs now obtainable.

Name .....

Address .....

Quick-Action Advertisements continued on page 6

## OFFICE DEVICES

**ADDRESSING** machines, multigraphs, duplicators, folders, check writers, sealers, dictating machines, at about half new cost. Pruitt, 170-2 North Wells, Chicago.

## MISCELLANEOUS

**RAZOR Blade Pocket Knife**—Money easy made by selling a handle for an old discarded safety blade. Sample mailed to agents on receipt 50c into or stamp. A. Tubbs & Company, 90 Plummer, Hammond, Indiana.

**MAKE** interesting new friends and receive daily letters. Send Stamp. Betty Lee, Incorporated, 4254 Broadway, New York City.

**MONOGRAMS**—for automobiles, ivory sets, boxes, trunks, cases, etc.—5 initials, instructions, 75c. Wrege, Lyndhurst, New Jersey.

**BURRER** stamps. Your name and address, 50c. Rubber Stamp Shop, Muncie, Indiana.

## ADVERTISING

**PUT** your advertising problems up to those who know. As president of the advertising agency of Douglas Wakefield & Co., Inc., New York, I have conducted campaigns for many of the national advertisers of America. What I have done for others I can do for you. And by doing it in my spare time you'll get maximum results at minimum cost. Letters, folders, booklets, advertisements written and illustrated. Explain your needs in first letter. References—H. G. Dunn, any magazine or newspaper. Address: Douglas Wakefield & Co., Inc., 906 Park Avenue, Woodliff, New York.

**FREE AD-Guide** giving interesting rates for advertising in magazines and weeklies. Concordia Magazine, 2DW, York, Pennsylvania.

**ADVERTISE** in 24 metropolitan dailies, 25 words, \$10. Refusal Guide listing 1000 publications, 40 stamps. Wade, Baltimore Bldg., Chicago.

**INCH Display Advertisements**, 161 Magazine, Union Bldg., Wood's Popular Service, Atlantic City.

**ADVERTISEMENTS**, letters, circulars, folders, booklets, convincingly written and attractively designed; any subject; 20 years' successful experience; my book, "Direct Advertising" free. Ernest P. Gardner, 800-A Ridge Arcade, Kansas City, Missouri.

**ADVERTISING** letters, booklets, circulars composed. Quinn, 4604 Lansdowne Avenue, Philadelphia.

**MR. ADVERTISER:** Ask to-day for a copy of the "Quick-Action Advertising Rate Folder." It contains some really important facts which will prove interesting and valuable to you. It also tells "How You Can Use Popular Science Monthly Profitably." You'd like to know, wouldn't you? Manager Classified Advertising, Popular Science Monthly, 225 West 39th Street, New York.

## WORK WANTED

**PUNCH** Press work, tool and die making model, and special machine work wanted. Completely equipped with new machinery of the latest type. Prompt delivery, reasonable prices guaranteed. Quality & Machine Co., Dept. B, 615-66 N. Clark St., Chicago.

## PATENTS FOR SALE

**FOR** sale—Patent expandable steel rim split pulley, J. Muller, 1842 Norman Street, Brooklyn, New York.

## SCENERY FOR HIRE

**SETTING** for Operas, Plays, Musicals. Plush Drops, Catalog. Amelia Grail, Philadelphia.

## PRINTING, ENGRAVING, MULTIGRAPHING

**LETTERHEADS**, envelopes, 500 \$2.50. Samples free. Quality Printery, Marietta, Ohio.

**100,000** 1 x 3" labels, \$25.00. 1,000, \$2. Save 20%. Wolf Labels, Station E, Philadelphia.

**BETTER** printing for less money! Read for our large package of samples of hundreds of items every user of printing is interested in. These samples worth dollars will be sent for 10 cents to pay postage. Ernest P. Gardner Company, 526 South Dearborn Street, Chicago.

**EMBOSSED** business, personal stationery. Samples, stamp. Daniels P. Company, Pittston, Pennsylvania.

**VISITING** cards, 65c 100; gum included. Letterheads, \$4.00 1000. Refusal, 822 Penn, Lancaster, Pennsylvania.

**LOWEST** prices on advertising. Penalties in quantity. Sample with your ad imprinted in gold, 10c. H. Stuart & Co., 424 Walnut Street, Yonkers, New York.

**200** letterheads and 20 envelopes, \$1.00, postpaid. Gebb, Watertown, Wisconsin.

**MR. ADVERTISER:** Ask to-day for a copy of the "Quick-Action Advertising Rate Folder." It contains some really important facts which will prove interesting and valuable to you. It also tells "How You Can Use Popular Science Monthly Profitably." You'd like to know, wouldn't you? Manager Classified Advertising, Popular Science Monthly, 225 West 39th Street, New York.

## POULTRY AND LIVE STOCK

**BREED** squabs. Book free. C. Rice, Melrose Highlands, 77, Massachusetts.

**SPENCER** turkeys—half turkey, half chicken. Photos, booklet, free. Spencer, R. I. Santa Cruz, California.

## PHONOGRAPHS, RECORDS

**BUILD** your phonograph. Quality phonographs. Highest quality parts and electric motors, tone arm, reproducers, amplifiers, case material and accessories. Free blue prints and building instructions. Big saving. Wonderful results. New catalog mailed for ten cents. Hoader Manufacturing & Supply Co., Phonograph Supply Department, 316 Holmden Block, Indianapolis, Indiana.

## CHALK TALKS

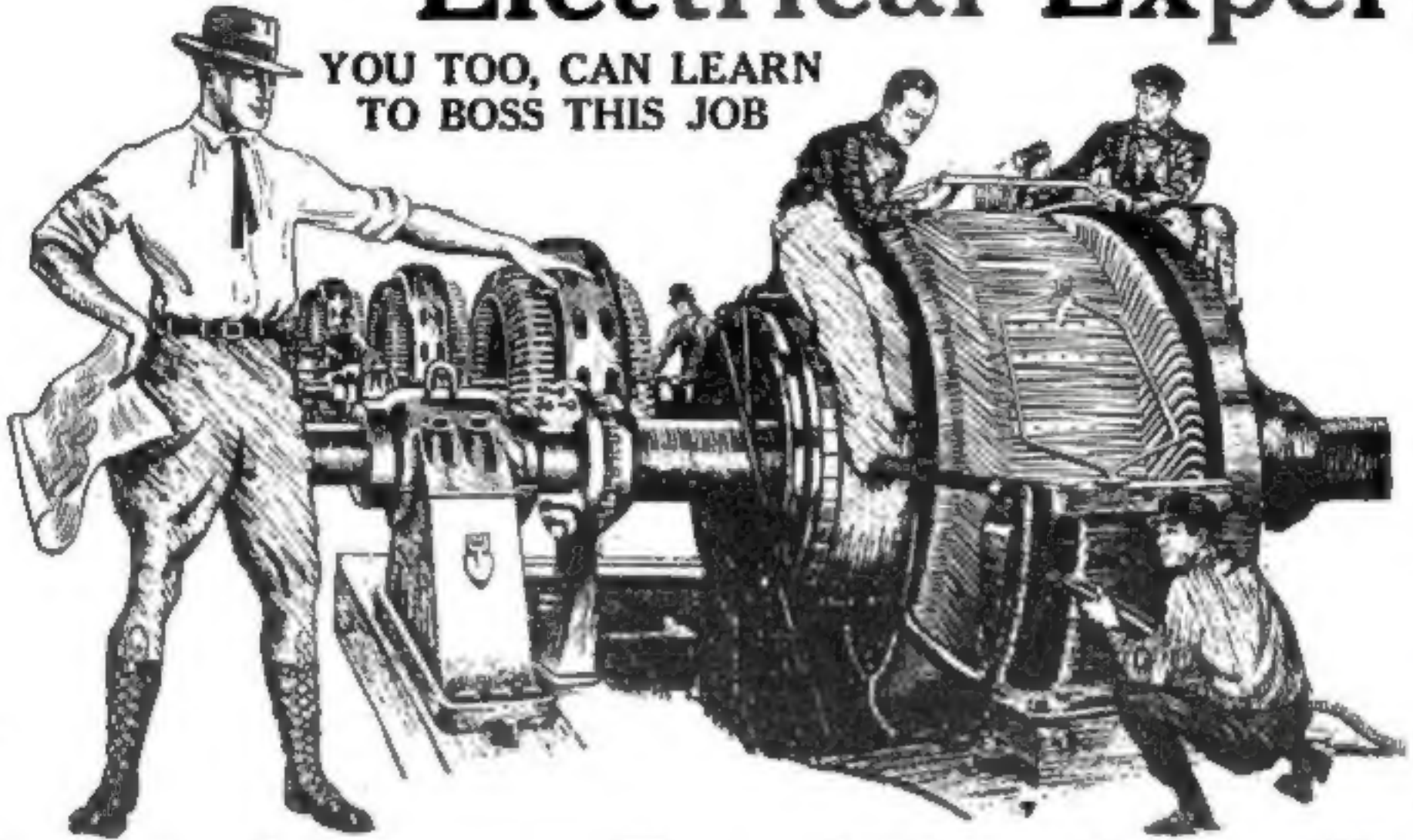
**LAUGH** producing program, \$1.00. Circulars free. Cartoonists Baida, Oakbrook, Wisconsin.

**MR. ADVERTISER:** Ask to-day for a copy of the "Quick-Action Advertising Rate Folder." It contains some really important facts which will prove interesting and valuable to you. It also tells "How You Can Use Popular Science Monthly Profitably." You'd like to know, wouldn't you? Manager Classified Advertising, Popular Science Monthly, 225 West 39th Street, New York.



# Be a Certificated Electrical Expert

YOU TOO, CAN LEARN  
TO BOSS THIS JOB



## Electrical Experts Earn \$12 to \$30 a Day

Trained "Electrical Experts" are in great demand at the highest salaries, and the opportunities for advancement and a big success in this line are the greatest ever known.

"Electrical Experts" earn \$70 to \$200 a week. Fit yourself for one of these big paying positions.

### Be an "Electrical Expert"

Today even the ordinary Electrician—the "screw driver" kind—is making money—big money. But it's the trained man—the man who knows the whys and wherefores of Electricity—the "Electrical Expert"—who is picked out to "boss" ordinary Electricians—to boss Big Jobs—the jobs that pay.

**Earn \$3,500 to \$10,000  
a Year**

Get in line for one of these "Big Jobs" by enrolling now for my easily-learned, quickly grasped, right-up-to-the-minute, Spare-Time Home-Study Course in Practical Electricity.

**Age or Lack of Experience  
No Draw-Back**

You don't have to be a College Man; you don't have to be a High School graduate. My Course in Electricity is the most simple, thorough and successful in exist-

tence, and offers every man, regardless of age, education, or previous experience, the chance to become, in a very short time, an "Electrical Expert," able to make from \$70 to \$200 a week.

### I Give You a Real Training

As Chief Engineer of the Chicago Engineering Works I know exactly the kind of training a man needs to get the best positions at the highest salaries. Hundreds of my students are now earning \$3,500 to \$10,000.

Many are now successful  
**ELECTRICAL CONTRACTORS.**

### Your Satisfaction Guaranteed

So sure am I that you can learn Electricity—so sure am I that after studying with me, you, too, can get into the "big money" class in electrical work, that I will guarantee under bond to return every single penny paid me in tuition if, when you have finished my course, you are not

satisfied it was the best investment you ever made.

**FREE—Electrical Working Outfit—FREE**

I give each student a Splendid Outfit of Electrical Tools, Materials and Measuring

Instruments absolutely FREE. I also furnish them with all supplies, examination paper, and many other things that other schools don't furnish. You do PRACTICAL work—AT HOME. You start right in after the first few lessons to WORK AT YOUR PROFESSION in a practical way.

**SAVE \$45.50 BY ENROLLING NOW**

You can save \$45.50 in tuition by enrolling now. Let me send you full particulars of my great Special Offer, and my Free booklet on "How to Become an Electrical Expert."

**L. L. COOKE**

**Chief Engineer**

**Chicago Engineering Works**

Dept. 37, 2150 Lawrence Ave., Chicago, Ill.

### Some Features of My Course That Make Your SUCCESS Certain

1. Practical Money-Making Instruction—no useless, high-sounding theory.
2. Free Electrical Outfit—Flameless outfit sent out for home experiment and practical use.
3. Free Employment Service (helps you get a good job).
4. Free Consulting Service (No chance to get stuck on anything, while studying or afterward).
5. Free Engineering Magazine.
6. Free use of my Electrical Laboratory.
7. Extra Courses Free—Radio-Electrical Drafting.
8. Spare-time work—special earn-while-you-study lessons.
9. All supplies and material furnished free.
10. Cash Refund Guarantee Bond.

These features are all explained in my big Free Book.

**L. L. COOKE, Chief Engineer  
Chicago Engineering Works  
Dept. 37, 2150 Lawrence Ave.  
Chicago, Ill.**

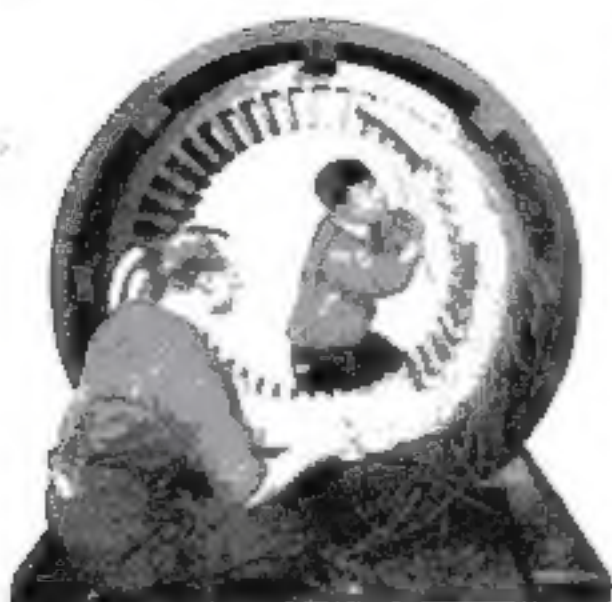
Dear Sir: Send me at once full particulars of your great Special Offer, including the "Vital Facts," sample lessons and your big Free booklet on "How to Become an Electrical Expert." No obligation on my part.

Name.....

Address.....

**The "Cooke" Trained Man is the "Big Pay" Man**





Student Winding a Stator

## Learn Electricity In 3½ Months

**T**HE whole world of electricity is open to the Coyne trained man. He is trained completely. He can make big money as Power Plant Operator, Superintendent, Telephone man, Construction worker, auto, truck or tractor electrician, battery man, radio expert, or he can go into business for himself as electrical contractor, dealer, auto ignition or battery expert and make from \$3,000 to \$20,000 a year. Hundreds of our graduates today are making big money and you can do the same if you grasp this opportunity—act now.

## Big New Home of the Great Shops of COYNE

The increased popularity of Coyne and a tremendous influx of new students simply forced us to move into larger and more spacious quarters. Here, in the big, new home you will find added electrical equipment—new and larger departments—a more complete electrical training.

### Earn \$150 to \$400 Per Month

No books or useless theory. You are trained on \$100,000 worth of electrical equipment. Everything from door bells to power plants. You work on motors, generators, house-wiring, autos, batteries, radio, switchboards, power plants—everything to make you an expert ready to step right into a position paying from \$45 to \$100 a week. Learn electricity in the electrical center of the world. Send coupon today for free catalog.

### Radio Course FREE

We include the following free with the regular course:

- (1) A complete course in auto, truck and tractor electricity and storage batteries. Greatest outlet of auto electrical and battery equipment in the country.
- (2) Course in Radio—the marvel of the age. Constructing, installing and operating. You can build your own wireless telephone set.
- (3) A life-time scholarship in the Coyne school. You can stay as long as you wish and return for further training at any time in the future.

**EARN WHILE YOU LEARN.** We help students to secure jobs to earn a good part of their expenses while studying.

### Send Coupon Now!

Don't delay a minute—send this coupon in right now for our big free catalog and full particulars of this wonderful offer. Act now!

**B. W. COYNE, President**  
Coyne Trade and Engineering School  
Dept. 10 1200-1210 W. Harrison St. Chicago, Ill.

**B. W. COYNE, Pres., Coyne Trade and Engineering School**  
Dept. 10 1200-1210 W. Harrison St. Chicago, Ill.

Dear Sir: Please send me free your big catalog and full particulars of your special offer of three extra courses.

Name.....

Address.....

#### EDUCATIONAL AND INSTRUCTION

**CORRESPONDENCE** school courses only one quarter original price. Send for free price list 1930 courses. Used courses bought. Students' Exchange, 47 West 43d Street, New York.

**BOOKKEEPING** in a week. Dues, 1507-59 Walton Avenue, New York.

**DOUBLE** entry bookkeeping mastered in 60 hours; guaranteed; diploma. International Bookkeeping Institute, Springfield, Missouri, Desk 10.

**LINCOLN-JEFFERSON** University. Home study in Academy College. Theological, Law, Music, Pharmacy, Business and Graduate schools, leading to degrees. Box 6, 61 W. Randolph Street, Chicago.

**USED** correspondence courses resold. Courses bought. J. J. Henderson, 134 Ridge Ave., Yonkers, New York.

**LEARN** Architectural Drafting. Big pay. Opportunities everywhere. Practical, inexpensive instruction. Easy payments. Write now. Designer Evers, Enclosed B. Denver, Colorado.

**USED** correspondence courses bought and sold. All prices are the lowest. A. J. Irenka, Newark, New Hampshire.

**HYPNOTISM** easily learned. Lessons Guaranteed. Postpaid \$1.00. Smith Publishing Co., Springfield, Mass.

**CORRESPONDENCE** Courses. Bachelors papers. Bulletin 1934 free. Used Courses bought. Instruction Correspondence Exchange, 1946 Broadway, New York.

**DEVELOP** your psychic powers and become a spirit medium. Instructive lessons free. Address: Circuit, Box 1331, Tampa, Florida.

#### LANGUAGES

**WORLD-Home** System. Mastery to All Languages. Printers, 15 languages, \$1.94 each language. Arabic, Chinese, Danish, Dutch, English, French, German, Italian, Japanese, Persian, Polish, Portuguese, Russian, Spanish, Swedish, Pronunciation Tables, 30 languages, 30¢ each language. Language Publishing Company, 4 West 30th Street, New York.

#### GAMES AND ENTERTAINMENTS

**YOU'LL** have lots fun exchanging chess letters to my club. Eva Moore, Box 908, Jacksonville, Florida. (Stamp)

**TRICKS** jokes, magic, puzzles. Catalogue free. Clifford Fennel, 1401 Madison, Louisville, Kentucky.

#### FOR MEN AND WOMEN

**GENUINE** Indian beaded and wampum—Wholesale Catalogue. Gilman, Maryville, California.

**BE** a Detective. Excellent opportunity and pay-travel. Write C. T. Ludwig, 424 Westover Bldg., Kansas City, Missouri.

**"SEXUAL** philosophy." 11¢. Clear, specific, authoritative, complete, best outlines. Fred B. Kamman, Lawrence, Massachusetts.

**ARE** you interested in the practical effects of Vibration and Color upon your life? It will pay you to answer this instructive literature free. Robert Ross, Box 728, San Francisco, California.

#### CIGARS, CIGARETTES, TOBACCO

**HOMESPUN** smoking tobacco—2 lbs. \$1.00; 10 lbs. \$1.75; 20 lbs. \$3.25. Farmers Union, Mayfield, Kentucky.

#### PHOTOGRAPHY AND SUPPLIES

**FILMS** developed 35 roll, prints 3¢ each. Photo Service, 979 Michigan, Cincinnati, Ohio.

**SPECIAL** Trial Offer. Any size Kodak film developed for 1¢; prints 2¢ each. Over-night service. Expert work. Roanoke Photo Finishing Co., 312 Bell Ave., Roanoke, Virginia.

**HAVE** you a camera? Write for free sample of our big magazine, showing how to make better pictures and earn money. American Photographer, 116 Camera House, Boston, 17, Massachusetts.

**MAKE** money with your camera. Booklet free. Lighthouse, 400E Wright-Cullender Building, Los Angeles, Calif.

**FILMS** Developed 35 roll—prints 3¢ each. Not ordinary kind—special studio finished. Reliable Studio Station 15, Cincinnati, Ohio.

**KODAK** Rushing. Kodak, cameras repairing. Developing and printing for amateurs. One day service. Complete line of photo supplies. Write Radcom Studio No. 22, 847 Belmont, Chicago.

**KODAK** Prints 3¢. Developing 3¢. Postcards 5¢. Altius Photo Co., Dept. W, 1942 Ninety, Cincinnati, Ohio.

#### AUTHORS—MANUSCRIPTS

**WRITE** for newspapers and magazines. Big pay. Experiences unnecessary. Details free. Press Reporting Syndicate, 409 St. Louis.

**WRITERS:** Have you a song-poem, story, photograph, or art? Submit manuscript now to Music Sales Company, 46 St. Louis.

**WRITERS:** Stories, poems, plays, etc. are wanted for publication. Literary Bureau, 171 Hannibal, Missouri.

**FREE** to writers—a wonderful little book of money-making hints, suggestions, ideas—the A B C of successful story and play-writing. Absolutely free. Just address Author's Press, Dept. 10, Auburn, New York.

**33¢** FOR Ideas. Photoplay plots accepted any form; revised, criticized, copyrighted, marketed. Advice free. Universal Scenario Corporation, 904 Western Mutual Life Bldg., Los Angeles.

#### FOR SALE

**UGER** pistols, barrels 4" to 16". Manner pistols, long barrels. Holster-stocks for buck. Paper accurate Master, Springfield and Mossberg rifles. Catalogue, ten cents in stamp. Pacific Arms Corporation, San Francisco.

#### MUSICAL INSTRUMENTS

**RAU** just piano, saxophone or tenor banjo in 30 lessons. Christianese School in most cities, or learn by mail. Write for booklet or money-making teacher's opportunity. Christianese School, 21 E. Jackson, Chicago, Illinois.

Quick-Action Advertisements continued on page 10

# California

## has a job for You

Come to sunny California, to Los Angeles, the city of your dreams.

### Learn Auto Trades In Coast's Biggest Schools

We'd like to take every page of this magazine to tell you how National Automotive has helped thousands of men to big pay auto jobs in California; how YOU can get a good job and earn big pay after a few short weeks training.

But we've told the story in a great big wonderful illustrated auto book. Send for YOUR copy—it's FREE.

### Your Success Is Sure After NATIONAL Training

Hundreds of men write: "I have increased my earnings 100%." "I have built a wonderful garage business, and owe it all to National." "I am well satisfied with National training; am sending my brother to take the course."

It's the National practical shop training that counts. Actual construction work on all types of motors. Ignition, battery and lather work—driving and vulcanizing. Special advanced electrical course FREE. You KNOW auto when you complete the NATIONAL course.

Special Low Tuition offer now. Earn your room and board, and a little more, while learning. Living expenses low in California—and it's worth a million dollars to live there. Find out about everything in interesting illustrated auto book. Mail the coupon now.

### Send for Free Auto Book

National Automotive School  
814 S. Figueroa, Los Angeles, Cal.

Please send me your 72-page illustrated auto book—absolutely FREE.

Name.....

Street No. ....

City..... State.....

**My new plan brings this man \$1076 an hour!**



L. G. Sprindler of Akron, Ohio, made \$1076 an hour the first time out! Almost took him off his feet! My men and women are cleaning up all over! One day made \$57.00 in one day! E. F. Oliver sold \$20 in two hours. W. C. Gibson took 99 orders in 2 days. W. H. Marlon got 34 orders from 40 calls. Why? The merchandise. It sells itself and you make over 100 per cent profit.

### An Amazing Opportunity

I will positively show you the biggest selling profits and opportunities that any manufacturer has been able to offer you. No training. No experience. The quality holds your customers, thus you are building a permanent, sound business that will keep you financially independent.

### Just Send Me Your Name

Just write me at once for full details of my proposition. There is no obligation—and it will mean real money for you. It's an honest to goodness opportunity! Write me this minute while you think of it. You'll never regret it.

**E. M. DAVIS, Dept. 1340 Chicago**

**E. M. Davis, Dept. 1340 Chicago**

Please send me full particulars of your new sales plan—and send that there's big money in it.

Name.....

St. No. ....

City..... State.....



# The "Big 4" in business say—



## It pays to read Business Books

**T**HE Big Pay Men in every business are the accountant, the financial manager, the production manager and the sales manager. How did these men get to the top? How are they holding their jobs? There is just one answer to both questions. The "BIG 4" are readers of business books. With these books they keep abreast of the times. If there is a newer and better way of doing things they soon know about it and put the new method to use. Today every successful business man has, in his library of up-to-date business books, a Silent Partner.

## Here is Your Silent Partner

Let this 8 volume Business Management Library be your Silent Partner. It is the newest and most comprehensive set of business books ever put on the market. It makes you familiar with all modern methods and shows you how to apply them in solving your own particular problems. It combines the sound principles of long standing with the new methods discovered and worked out during the late reconstruction period. It takes the cognizance of none but well established practical methods. This set is divided into 4 parts: Sales and Advertising, Production, Accountancy and Finance. Each part is complete in itself in 2 volumes. There is no overlapping or duplication between the different parts but through each part goes the common key note of managerial control.

### Theory and Practice of Accounting

*Its Use in Managerial Control*

The majority of accountants bite their teeth out on business mathematics and do not digest the much more important knowledge of managerial control. As a result they do not know the policies and aims of the other three divisions in their business and fail in giving cooperation. In this work the value of correlations and how to obtain it is thoroughly explained. These two volumes contain about 500 pages, well illustrated with charts and diagrams. The author is H. Eugene Bell, M. B. A., Professor of Accounting, University of Texas.

### Financial Management

*Outline of Its Principles and Problems*

There are many ways to finance a business. But which one is the correct method for your particular business? That question has been answered disastrously by many a concern these last three years. Take for instance that eastern concern making watches. Old fashioned financing—and that alone—put it into bankruptcy. A careful study of this part of Business Management could have saved the firm. This part is in 2 volumes of about 500 pages and much illustrated matter. Its authors is James M. Kinsey, A. M., L. L. B., C. P. A., member of the firm of Frazer & Torbet; author "Bookkeeping and Accountancy" and "Budgetary Control."

### Production Management

An exceptionally helpful work in which the psychology of production is put to practical use. Contains many new methods which up to now have never been published although they are

in use in some of the most successful plants in the country. The author shows that most so called common sense is but dangerous guesswork. This part comes in 2 volumes of about 500 pages, many charts and descriptive illustrations. It was written and compiled by A. M. Simons, B. L., author of "Personal Relations in Industry," "Social Forces in American Industry," Director Foreman Training, American School, formerly Lecturer of Personnel Relations in the Extension Dept. of the University of Wisconsin and Manager Personnel Dept. Leffingwell Ream Company.

### Sales and Advertising Management

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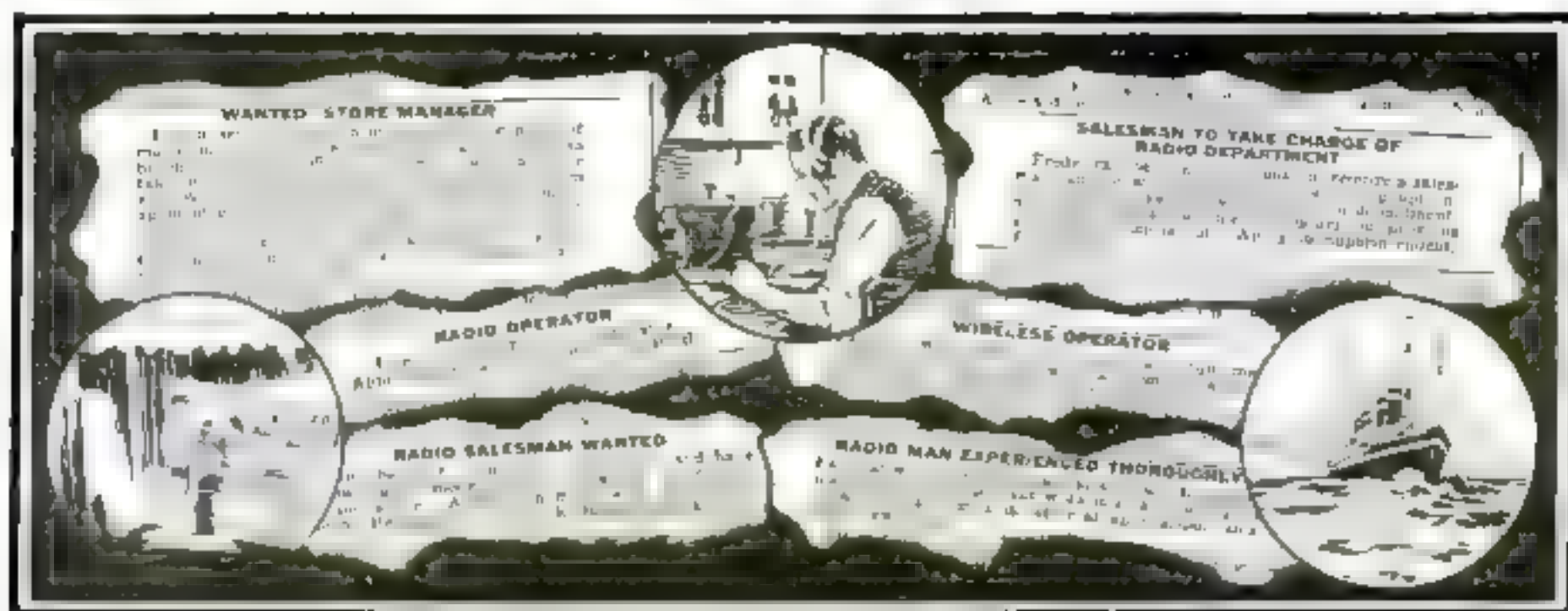
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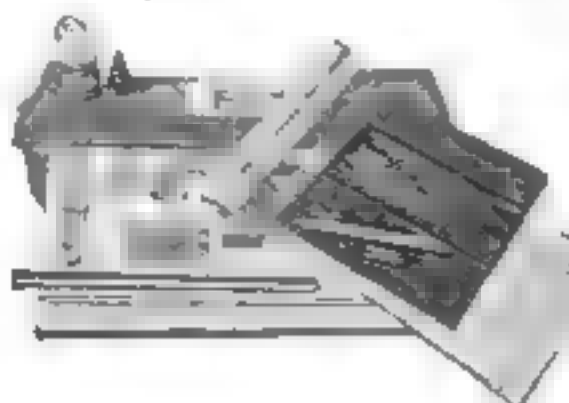
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A practical system of constructive thinking that brings business and personal achievement

# The Secret -of- Mental Power

"Why do so many men never amount to anything? Because they don't think."  
—Edison

**M**ARK TWAIN more said that the average man didn't make much use of his head except for the purpose of keeping his necktie from slipping off.

And Prof. William James claimed that the average man uses only about a *twentieth* part of his brain.

And Thomas Edison states emphatically that most men never amount to much because they don't *think*.

How about you? Are you using your head simply as a scarf-retainer? Are you using only 10% of your brain? Are you sitting, discouraged and discontented, at the foot of the ladder simply because you don't *think*?

It will pay you to find out.

*Mind* is the measure of every man. *Mental power*—not physical power—wins business battles and builds bank accounts.

The man with *brains* to sell fixes his own price, but the man who brings only *brains* to market must be satisfied with the lowest wage that brute force brings.

In every age, in every clime and in every field of human endeavor the *trained thinker* wins where the *thoughtless toiler* fails.

Twain, James, Edison, Roosevelt, Rockefeller, Schwab, Carnegie, Woolworth, Wanamaker, Morgan, Hill, Harriman, Ford, Marconi, the Wright brothers and all other successful men reached their goals not because they knew how to use their *muscles* but because they knew how to use their *minds*. Does anybody doubt that? Isn't it admitted by all? Doesn't every one with "brains enough to grease a ginnet" know that it's true?

## Only One Road to Success

Yes, indeed, there is only *one* road that leads to success and that is the *mental* road. If you expect to accomplish anything worth while by any other method than the *development* and use of your mental facilities, you are simply deceiving yourself. And the biggest fool in the world is the man who fools himself.

A recent magazine article states that intelligence tests in this country disclose the deplorable fact that 83% of the people are morons. You won't find the word "moron" in many dictionaries. It means a person with the mental development of a normal fourteen-year-old child.

Is it any wonder why so few people achieve any considerable success in life, when such an enormous percentage of them are so lacking in mental power? Such people have no more chance in competition with trained minds than a midget has to lick Jack Dempsey.

And isn't it simply absurd, when you stop to think about it, that most people are striving for success and yet they are doing absolutely nothing to strengthen and develop their *minds*, which is the only part of them with which they can ever hope to win success.

The principal reason that the trained *thinker* gets ahead is because he has so little competition.

The *unthinking toiler* works hard for small pay because almost anyone can do his work.

What are you doing—as the days go by—to develop your mind? Are you more efficient mentally than you were a month ago—or a year ago? If not, you are standing still. You haven't even started on the road that leads to *bigger and better living*.

## Missing Success By a Hair's Breadth

The difference between *success* and *failure* is often but the breadth of a hair.

The man who is making *twice* as much as you are has nowhere near *twice* the intellectual ability. The man who enjoys an income of \$10,000 a year is not *five* times the mental superior of the man who receives only \$2,000.

## Get this FREE BOOK

If you are interested in learning

- How to think like an arrow.
- How to compel attention.
- How to master important problems.
- How to overcome fear and worry.
- How to "tune up" your mental motor.
- How to develop new methods.
- How to originate new ideas.
- How to learn quickly and easily.
- How to attract valuable friends.
- How to have more time for play.
- How to out-think the average man.
- How to make your mind a mental sword.
- How to stop thinking in circles.

Thousands upon thousands of earnest, aspiring men are almost successful. But in this connection a miss is as bad as a mile.

With just a little more mental force—with a slightly better trained mind—with a little clearer knowledge of *right thinking*—hundreds of men who are now struggling along in the *Poor-Pay Army*—footnote and weary—would immediately find themselves equipped to command from *two to ten* times their present incomes.

Probably the man who makes \$1,000 a month is only 10% to 20% better trained mentally than the man who is trying to make both ends meet on \$100 a month. This is a fact. And it should be a most encouraging fact to every man who wants to be somebody and *get somewhere*.

The greatest thinkers the world has ever known have hardly more than scratched the surface of their latent mental powers.

Improve your mental power only 10% and you will *multiply* your earning capacity.

## Get This New Book

We have just published a new book—*The Secret of Men as Power*. We will gladly send you a copy upon request with our compliments and good wishes. And we want to state as forcefully as we know how that you will find it one of the most interesting and mind-spurring books you ever read.

If you had to quit work for a month in order to get and read this book, it would probably be one of the most profitable months you ever spent. But you don't have to do that. It takes but an instant to sign the coupon. You get the book for nothing. And you can read it in twenty minutes, as it is a small book of 52 pages and 16 illust. pages.

Send for a copy of this book today. It tells about the most practical common-sense system of constructive thinking—the easiest and quickest method of mind building ever discovered—the secret of developing mental power in a way that is as fascinating as a game.

This book shows you the difference between *disordered irrational faulty thinking* and *ordered normal true thinking*.

It shows how you can tell by a man's appearance whether he is a *true thinker* or a *false thinker*.

It shows how a *wrong thought* produces a *wrong action* that brings a *wrong result*. And how a *right thought* brings a *right action* that can bring only a *right result*.

It shows the immediate and favorable result of *right constructive thinking* and the disastrous results of *faulty disordered haphazard thinking*.

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# This Millionaire Makes Science a Hobby

*H. L. Doherty, Traction Magnate with 150 Patents to His Credit, Is One of America's Greatest Inventors*

By James H. Collins

**W**E WERE sitting in Henry L. Doherty's "back yard"—the strangest corner of a strange aerial home of one of the most interesting business men in the world. Perhaps you have heard of the unique skyscraper bungalow that this millionaire utilities magnate, inventor, and financier has built on top of a tall office building in lower New York. Perhaps you have read how, in his "electrified bedroom," with its magnificent view over New York harbor, the gray-haired genius of traction and gas spends many an evening reading in his "automotive bed," which, when he is ready to sleep, rolls smoothly out of the room, at the touch of a button and travels along its tracks to a skyscraper sleeping porch. Then its occupant presses other buttons on the control box beside him, the doors of the room automatically close behind him, the sun porch windows adjust themselves to his pleasure, and he is ready for a cool night's sleep under the stars.

Well, Henry L. Doherty's "back yard" is a partial bit of "skyscraping veranda," just around the corner from this electrified open-air bedroom of his own devising. And there it was, surrounded by evidences of his interest in science—such as his radio set on its rubber-tired chassis—that Henry L. Doherty sprang this thought on me.

## How Doherty Values Science

"If I were re-designing Henry Doherty's career, I'd make it 95 per cent scientific and technical, and five per cent administrative. Unhappily, the ratios have been just the other way."

He had been talking about mechanical hobbies, the recreational value to the man of affairs that comes from a keen interest in science, and the part that curiosity about "why the wheels go round" plays in building a man's success. And he had confessed to over 150 patents—many having basic value in the public utilities field—to say nothing of hundreds of other unpatented inventions made for his own amusement. Yet—according to this business man-inventor—science and mechanics had not played a big enough rôle in his life!

Many a hard-headed business man is inclined to patronize anybody who turns to scientific and mechanical recreations, or confesses to joy in inventing things. Yet here is an inventor as hard-headed a business man as any of them—a man who swings some of the biggest business affairs



Henry L. Doherty, business man, inventor, and engineer, numbers among hundreds of unique inventions, this automo-

of the nation, whose companies in 200 communities serve over 4,000,000 Americans with gas, light and electric power and whose street railways transport 95,000,000 passengers a year—nearly as many as the entire population of the United States.

## A Newspaper Lad's Achievement

Mr. Doherty's business career began at the age of 11 when he sold newspapers up and down the main street of Coney Island, where he was born May 13, 1879.

A short time later he secured the employment of the Coney Island Traction Company as an office boy and through his tireless efforts soon advanced himself to the position of a primary school education. At the age of 17 he had achieved recognition as a budding genius.

It was not at all uncommon in his early career to find Doherty working on a radio or a mechanical puzzle and making money when a short



tive bed which, at the touch of a button, rolls out onto his spacious and airy skyscraper sleeping porch.



period, produce more efficiently than they ever had before.

Mr. Doherty managed gas and other utility properties in all parts of the United States until, in 1910, he decided to branch out for himself. In that year, he formed in Delaware the Cities Service Company as a holding company to acquire securities of electric light and power, natural and artificial gas, steam heating, water, electric interurban railways and kindred corporations. The management of natural gas properties in the mid-continent fields brought an expansion of the activities of subsidiary companies, so that Cities Service Company has become, through its subsidiaries and associated corporations, one of the most important factors in the oil producing, transporting, refining and distributing industries of the United States.

### Electricity as Man's Servant

And all this time he was inventing. Right on the heels of some brilliant achievement such as a device for washing and cooling gas, comes an invention for personal comfort and convenience, such as the "automotive bus" which is but one "division" in a homogeneous electrical control system that, at the push of a button or the turn of a knob, gives immediate service in any nook or any room in his aerie dwelling. Swinging at the head of his bed, for example, is a desk and book cabinet holding outside and house telephones and connections for supplying an electric fan and heating pad. Throughout the house are 64 of these convenience outlets and about the same number of plug receptacles for Mr. Doherty's telephones.

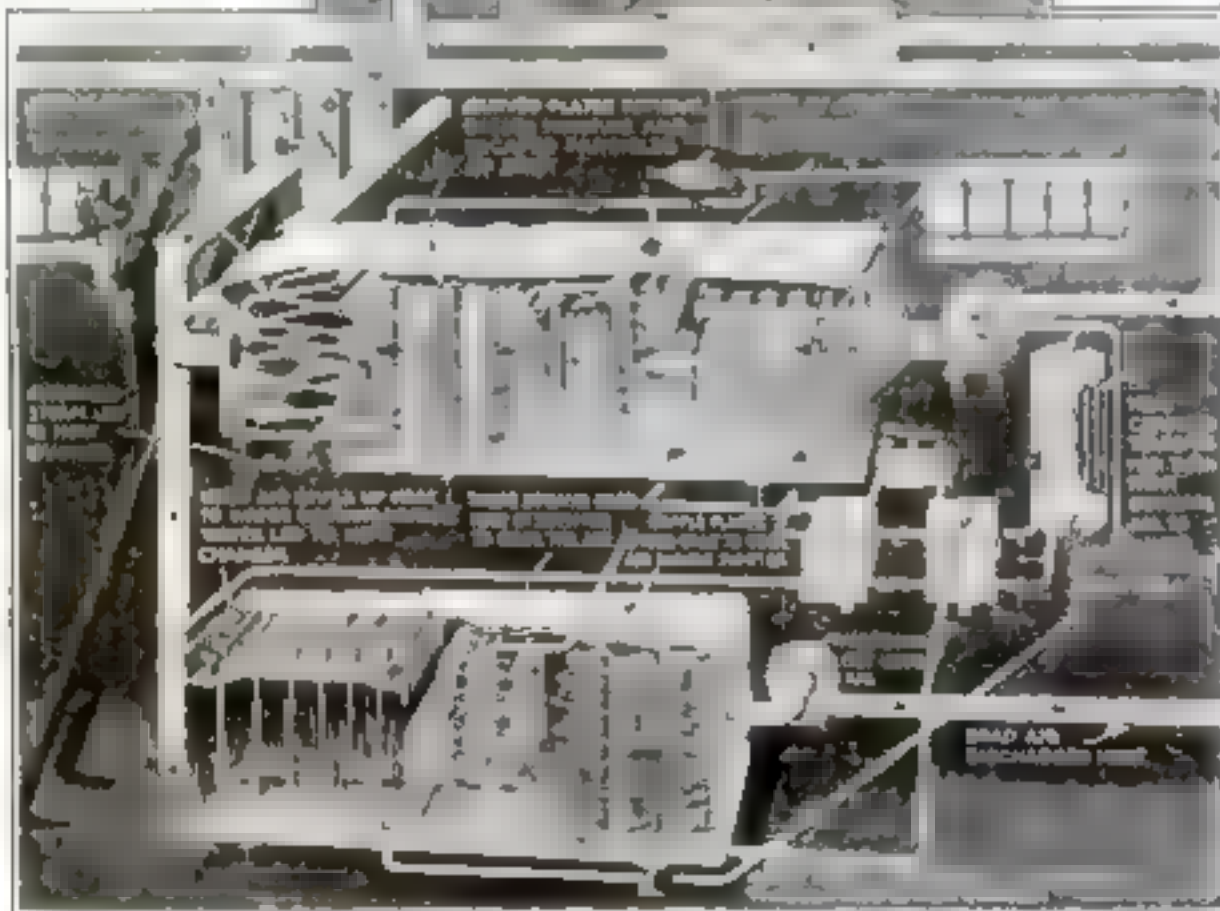
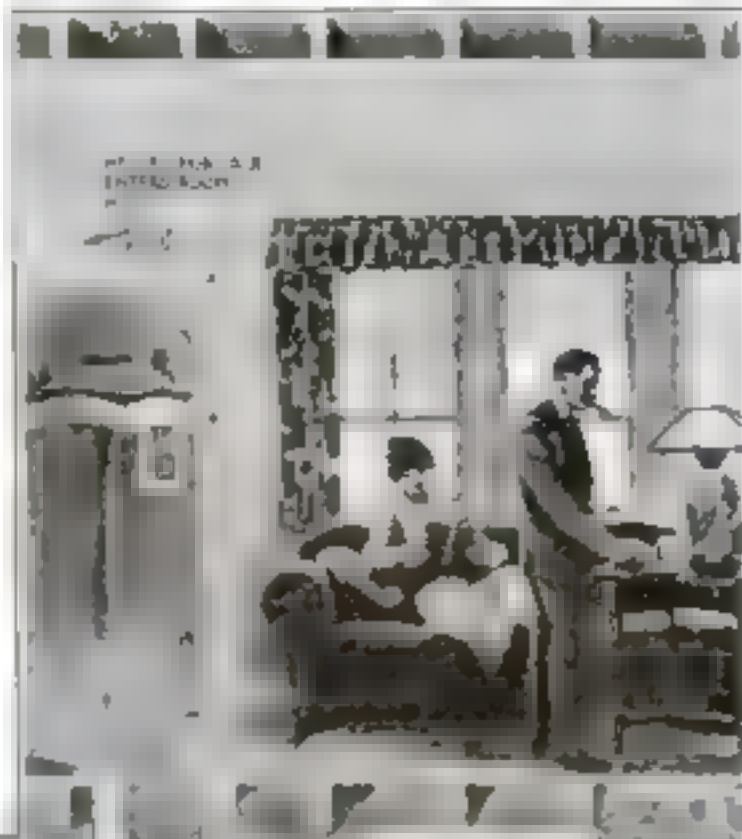
But of all the conveniences, the one that gives him the keenest enjoyment is his perambulating radio outfit. This two-stage set, mounted on a four-wheeled carriage, can be wheeled from room to room, for in each room is a plug connection with the radio aerial and ground.

"Were you fond of tinkering as a boy—taking things apart to see how they worked?" I asked him. "Did your mind run to mechanics and engineering?"

"I had a good bump of curiosity, but it was hardly mechanical," Mr. Doherty said. "Until the war, I thought I had an engineering faculty, but experience during those years led to stock-taking, and now I believe my bent is more scientific and analytical. I never took things apart to see how they worked. I was always more interested in the 'why' of a thing than its 'how.' My natural mechanical ability

**"WHENEVER you see any human being doing any form of labor, remember that electricity will either do that labor, lessen the amount of that labor, or contribute to the comfort of the laborer."—Henry L. Doherty.**

would be rated pretty near zero. In the laboratory, for instance, I was a bull in a china shop, breaking more glass than everybody else put together. I remember an old chemist of ours who dreaded my



### A Doherty Invention

**TYPICAL** of the mechanical ingenuity in 150 inventions that Henry L. Doherty has patented is the above complex apparatus, devised to maintain pure air, even temperature, and healthful humidity in houses, hotels, or offices. In summer the heat of the vitiated air is removed by water sprays and air cleansers. In winter the heat that would ordinarily be discharged with the outgoing air is reclaimed by transferring it to the incoming cold air, effecting a real saving in fuel.

Mr. Doherty confesses to scores of inventions made for his own amusement and never patented, while many of his patented devices are of basic importance in the public utility field.

coming into his workshop. One morning he walked into the laboratory to find the open sky over his head. During the night, a wind storm had taken off the roof. "Mr. Doherty has been here," was his caustic comment.

One day, about 10 years ago, the writer was surprised by a telephone invitation to sit in a conference with Mr. Doherty. It was a gathering of electrical men. Mr. Doherty had been asking himself, "Why, with thousands of electrical conveniences right at hand, do women still push brooms and dusters around their homes, and mechanics drive tools by muscle power?" Mr. Doherty has preached this thought to the electrical fraternity until it has become almost a slogan: "Whenever you see any human being doing any form of labor, remember that electricity will either do that labor, lessen the amount of that labor, or contribute to the comfort of the laborer." After a morning's discussion, he decided that housekeepers endured drudgery simply because they didn't know any better, and that it was up to electrical men, whenever they found people doing a thing by hand, to show them how it could be done by electricity.

One snowy holiday, the winter before last, he stayed home, thinking it a fine chance to catch up with a lot of work. Looking down into the street where men were struggling to make a channel for traffic, his mind went to work on the snow problem. His habitual "why?" applied to all the pushing, shoveling, and hauling, suggested to him an entirely different way of dealing with snow—that of compressing it by machine into bricks and piling the bricks at whatever point on the street would least obstruct traffic, and letting them melt later and run off.

### "Why?" the Keynote

"What sort of machine would you use?" I asked him.

"The machinery could be devised easily enough," he replied. "You have the principle already in brickmaking machines that squeeze out a continuous slab the length and height of a brick, and cut off individual bricks the right width faster than you can carry them away. Loose snow will compress to one tenth its density."

All this is characteristic of his mind and work—to find out why a certain thing is being done a certain way, decide that it can be done better, and then hand the details over to others.

Doherty's apparatus for washing and cooling gas, though patented, has been widely infringed—testimony to its basic value. It was formerly customary to cool illuminating gas by passing its heat through a metal diaphragm to either air or water. Doherty's method is that of showering water through the gas, then passing this



water through a small cooler and back again as a spray in the gas. Heat will pass through a thin metal diaphragm from water to water nearly 100 times faster than from air to water.

### Other Important Inventions

His oil-spray for making water gas with the minimum amount of oil impinges two jets of oil exactly upon each other, vaporizing the oil in such minute particles that it is completely absorbed by the hot gas before it can reach the incandescent walls of the apparatus and be burned and lost.

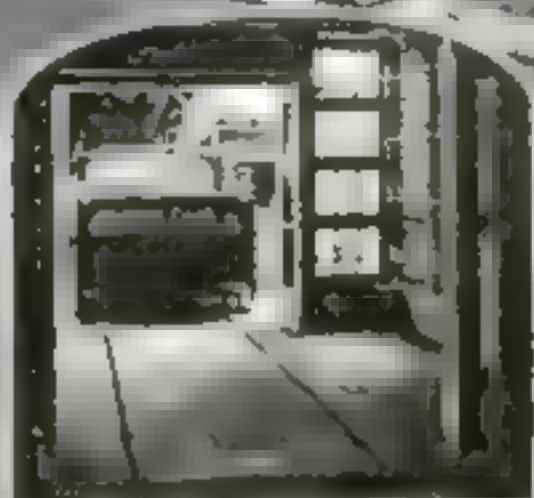
One of Doherty's most important inventions is a cinderless furnace. Hundreds of furnaces in the United States operate under Doherty patents. He has succeeded in burning any kind of fuel without the formation of any cinders and yet has been able to get in his combustion chamber as high temperatures as any refractory material will withstand, also securing a very great economy in fuel.

Capping a tall building overlooking New York Harbor at the Battery is Mr. Doherty's "electric home," indicated by the circle at the right.

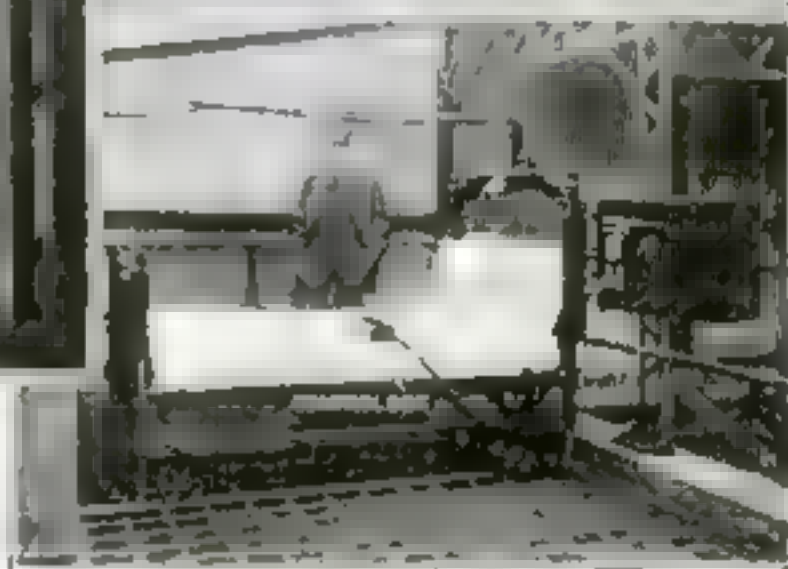


Interior View of the "Electric Home" at the Battery.

Mr. Doherty listening to radio weather reports with his perambulating radio outfit, for which there are aerial plug connections in each room of his home at the "top of the world."



Certain buttons are pushed and, presto! doors swing open and the auto bed rolls on tracks to the sleeping porch. If a storm arises, at the touch of a button the bed rolls its occupant back to shelter again.



On the automobile-bed pictured above is the control box with its pushbuttons for operating the bed and adjusting doors and windows. Swinging on the bed post is a desk and book cabinet containing the telephones.

His calorimeter for measuring the heat value of gas has eliminated cumbersome apparatus and given exact measurements automatically. Formerly, the gas to be measured was carefully metered and then burned to heat water, and its B. t. u. was then calculated from the weight and temperature of the water. In Doherty's calorimeter neither the water nor the gas is measured, but the heated water in turn is used to displace a like quantity of gas from the displacement chamber, and from the exact relationship of volume between gas and water the calorific value of the gas can be immediately determined.

Mr. Doherty's inventive faculty seems to swing between highly technical problems, like those involved in his gas-making devices, and the improvement of cities.

"Have you specialized in city problems?" I asked him.

"No—or at least not until very recently. It is only because I have been supplying services to cities all my life that I look on them in this way. Take street transportation, for instance. It has been a terrific problem to meet the ever increasing demand. This is due largely to an inequitable system of charging. So long as we

continue to charge a flat rate for a ride, no matter how long or how short it may be, we are continually encouraging long rides and discouraging short rides. When we charge according to distance, people will live nearer to their work or business. 'But that will increase congestion in our cities,' is the objection. On the contrary, it will decrease congestion, for our industries always tend to spread out into the outlying sections where land is cheaper, and employees will live in communities around them, a safer, healthier life for everybody.

### Carfares Should Vary with Distance

"Already we have taught people to enter street cars at one end and leave at the other. If we were to put a speedometer on the car to measure the distance units, the passenger could withdraw a ticket on entering the car upon which would automatically be registered the point at which he got aboard, and we would then charge him a fixed amount to ride, the loading and unloading expense, plus a charge for each unit that he rides—and he would pay as he leaves the car."

"Pay-as-you-leave cars, eh?"

"That's the idea. When people can ride 25 miles for a nickel in New York City, they must rob the company on the long haul, and the company has to get even by robbing them on rides of a few blocks. They naturally blame each other for the fault of an outgrown, uneconomic system."

Just what is the secret in this successful financier's method of thinking, working and playing, that has given him such extraordinary ability to analyze a difficult situation, to quickly place his finger on a solution, and to point out how things may be done better than they are?

Mr. Doherty supplied the answer in an illuminating stock-taking of his life work.

"Looking back over the career of this chap Doherty," he observed reminiscently, "I'd like to re-design him on better lines. Science and inventions have been my recreation, but they should have been more. My first work, as a newsboy in Columbus, was the most interesting I ever had. In the gas industry I found a broader field and was absorbed in its chemical and engineering problems. But gradually, as I rose from position to position, the financial and administrative business took more and more of my time."



# Is Einstein Wrong, After All?

## How Theory of Relativity, Questioned in Recent American Experiments, Will Be Put to Test in Coming Eclipse

**I**S EINSTEIN'S theory of relativity about to be consigned to the scrap-heap?

Breaking upon an astonished public some three years ago, turning our conception of the universe topsy-turvy, seeming to be completely accepted by scientists, it now appears possible that the theory of relativity may have to be considerably modified as a result of recent experiments with light rays carried out in California, on the top of Mount Wilson.

And while Einstein is being thus put to the test by American physicists here at home, another group of American scientists have undertaken a 16,000-mile round trip to Australia, for the purpose of testing the Einstein theory by the light of the stars. When the total eclipse of September 21 sweeps over a lonely beach some 100 miles from the northwest coast of Australia, Dr. W. W. Campbell, of the Lick Observatory, will attempt to discover whether light from the stars is actually bent, as it passes by the sun, while other astronomers — British, Dutch and German — at remote points along the path of the eclipse will likewise try in a few brief moments to read in the heavens the truth or falsity of what is one of Einstein's chief premises.

It seems then, that during the present month everybody will be watching with fascination the outcome of two different sets of experiments, which will determine the fate of the first theory in the history of science. The experiments are to cause universal popular excitement. Einstein himself has stated that there are probably only 12 men in the world who can understand his work, and yet from the very moment when it dawned on public consciousness, Einstein became a figure of worldwide fame. His name leaped to every tongue. When the great Swiss scientist came to this country he was fêted,

mobbed, almost overwhelmed with attention and publicity. People realized that Einstein was a man who had brought a tremendously revolutionary thought into the world, and they were intensely interested.

For more than a century science had assumed the existence of the ether as an all-pervading medium, in which light rays were transmitted by vibration. The theory seemed to explain light, and electromagnetic and radio phenomena as

well. He reasoned that, since the earth moves through the ether at a rapid rate it must have the effect of producing a "gale" of ether blowing all around us. And a light ray, he assumed, ought to take longer to travel against this gale of ether than with it.

Think of the experiment in terms of a rowboat on a swiftly

At left, path of eclipse of September 21, with location of American observing party at Ninety Mile Beach, and of Dutch-German party at Christmas Island.

flowing river. If you row from one bank toward the other, your boat does not travel directly across, but a little downstream, according to the swiftness of the current. Now, if you imagine a ray of light crossing a stream of ether analogous to the river current, it is natural to assume that it will take the light a little longer to travel a given distance across than it would to travel the same distance downstream with the ether current.

Professor Michelson, with the assistance of Professor E. W. Morley, a neighboring scientist of Western Reserve University, constructed an apparatus for splitting a ray of light and sending one half the ray across a table in the direction of the travel of the earth, or against with the ether drift, and the other half of the ray at right angles to the first, or straight across the ether drift. These rays were then reflected back to a telescope, where it was supposed the light waves composing the retarded half of the original ray

would be "out of step" with those of the other. Instead of combining crest to crest, they would combine crest to valley, so that streaks of black would be seen where they neutralized each other. Such streaks are

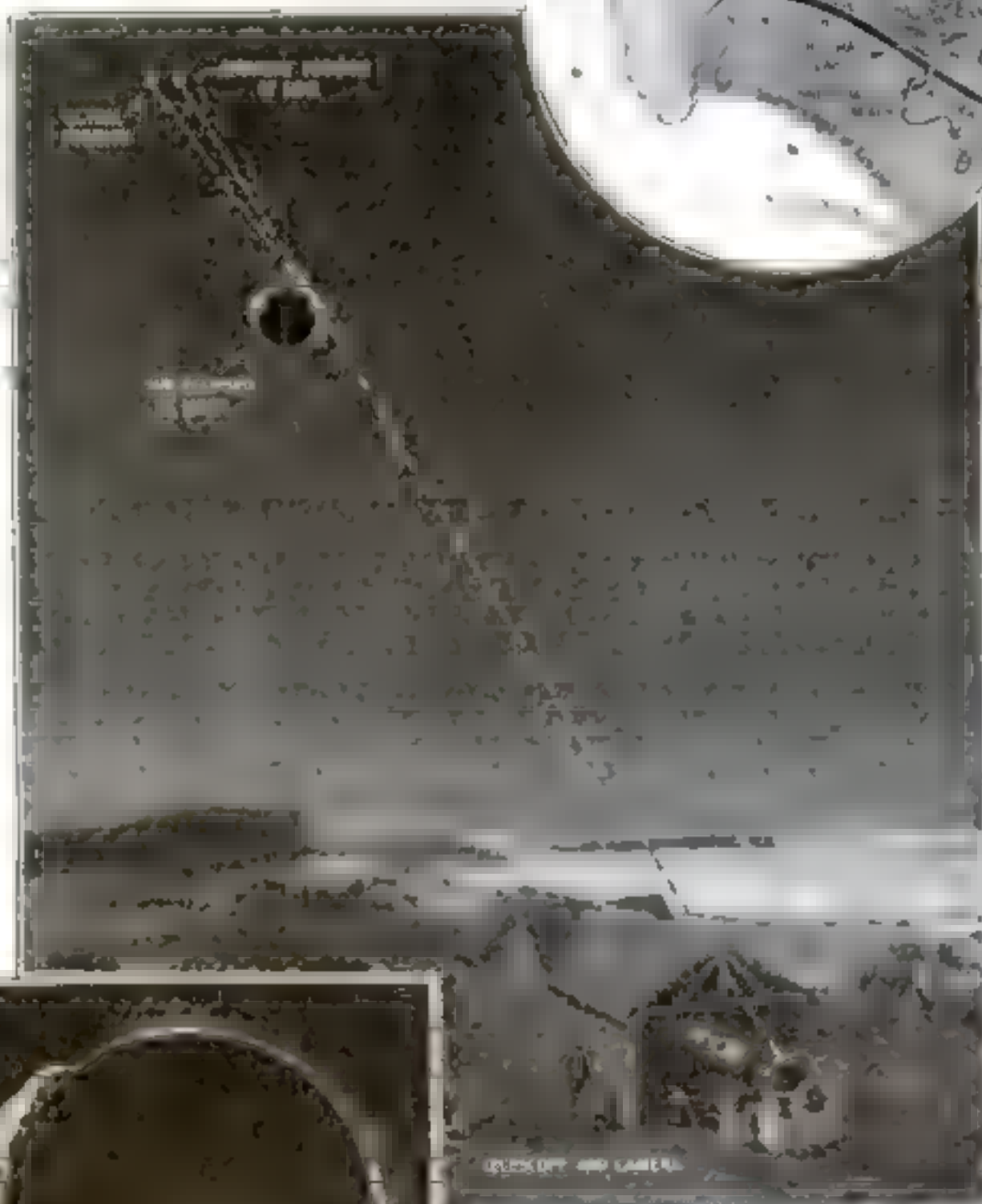
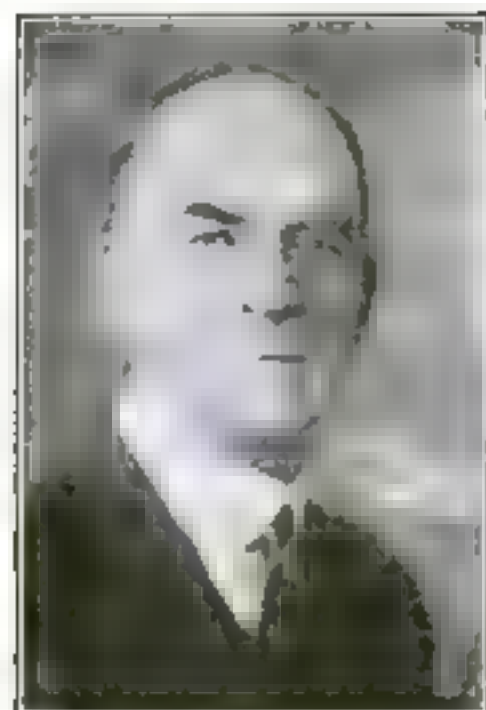


Photo courtesy Royal Observatory, Greenwich

**H**OW American astronomers will photograph the region around the sun during the eclipse of September 21. Their photographs will show star positions apparently displaced as indicated above. It will be expected that the star rays were bent by the sun's gravity. At left, close-up of a solar eclipse showing sun's corona and vast prominence of surrounding gases.

well. But no really conclusive evidence of the ether's actual existence had ever been sought until, back in 1887, Professor A. A. Michelson, of the Case School of Applied Science, Cleveland, devised a novel experi-





Dr. W. W. Campbell, chief of American astronomers, now in Australia to study the solar eclipse

called "interference bands," or "fringes," and the apparatus an "interferometer."

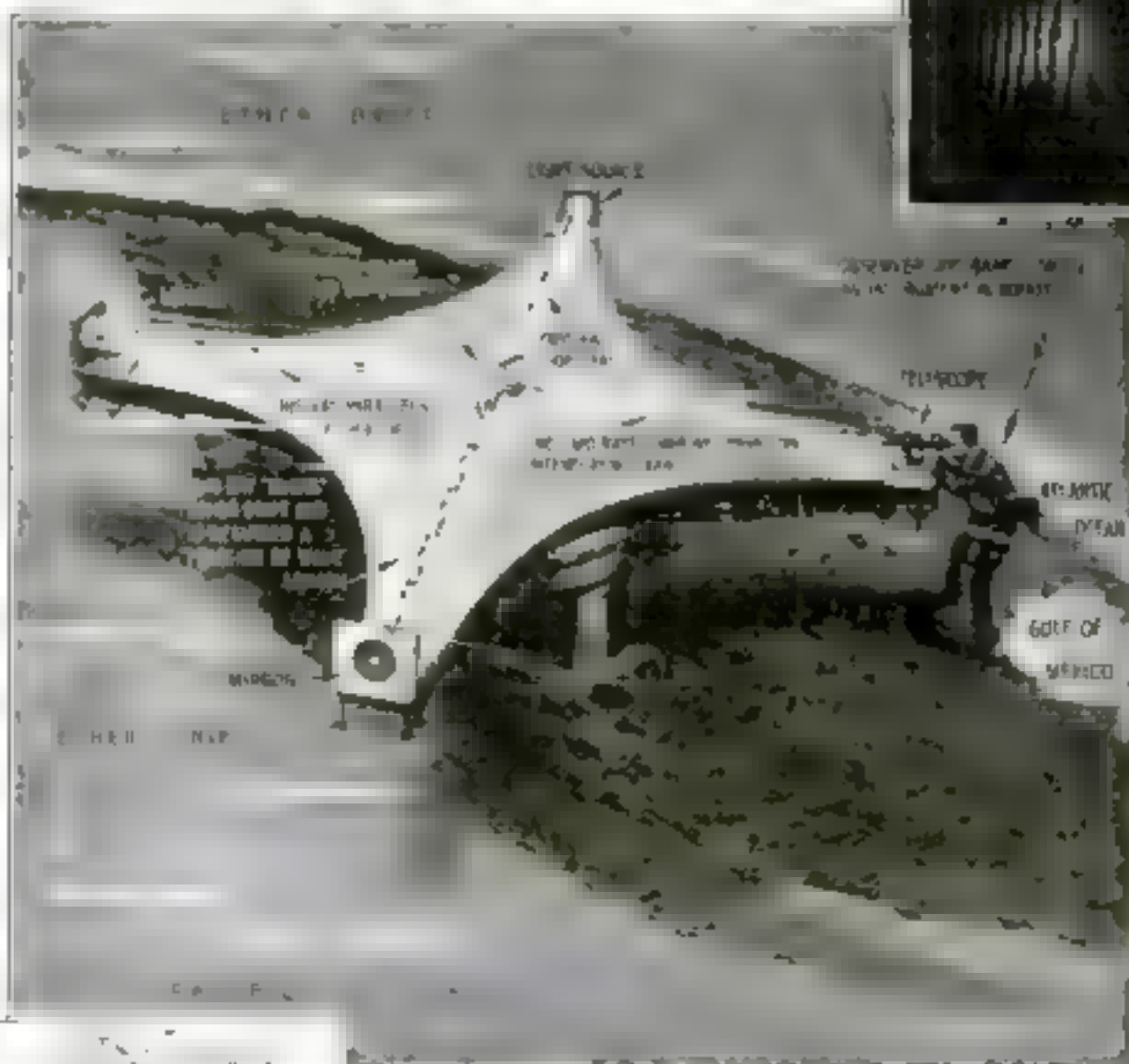
But in this now historic "Michelson-Morley experiment" of 1887, no interference fringes were seen. The two halves of the split ray seemed to return to the telescope in perfect step, with wave crest matching wave crest. The experiment "had negative results" but seemed to prove, if it proved anything, that there wasn't any ether—that light traveled through absolutely empty space, at a fixed speed.

Einstein promptly took this non-existence of the ether as one of his major premises. "If there isn't any ether, I shall create a theory that doesn't need it," he said. He came to the conclusion that light is transmitted, not by vibrations in an ether, but in the form of infinitely tiny "corpuscles" emitted from the light-giving body. These, being material, would be subject to the attraction of gravity. In other words, rays of light from the stars passing close to the sun should be bent inward by the sun's gravity. Here is where the famous astronomical experiment of 1919 came in. During the eclipse of that year, astronomers apparently definitely detected the bending of rays of light from the stars as they passed by the sun. It was this discovery — fulfilling almost exactly Einstein's predictions — that brought about the immense popular interest in the Einstein theory, although the theory itself was already 15 years old.

**T**HE nature of Professor Dayton C. Miller's light ray experiment to test the Einstein theory, as described in the accompanying article, is made clearer by the illustrations below. It consists, briefly, of sending a light ray across a table and splitting it into two separate rays that follow different paths, one parallel to and the other across the supposed "drift" of the ether. In Doctor Miller's most recent experiments, the split rays, when recombined, showed in the telescope alternate fringes of black and white. This result, if confirmed, may indicate that one of the rays was delayed in passage, and the existence of an ether, denied by Einstein, may be assumed to account for this delay.



Below, diagrammatic illustration of Professor Miller's apparatus, as set up on the peak of Mount Wilson. At right, the printer and "interference bands" seen in telescope



Sketch at left illustrates one suggested reason why no effect was obtained in a cellar in Cleveland, while atop Mount Wilson the experimenters got a definite result in attempts to prove existence of ether



Albert Einstein, whose theory of relativity is again on trial before astronomers and physicists

will propel some of the water with it. Therefore, Doctor Miller decided to perform his experiment on the top of a hill, and Euclid Heights, near Cleveland, was chosen as the site.

This time the experimenters were rewarded by the sight of very definite interference fringes in the telescope. The result was much smaller than expected, but it was still a definite result. For the first time in history, man seemed to see the earth move in relation to space, or absolute motionlessness. All other observed motion of the earth had been in relation to some other supposedly moving body.

The effect, unfortunately, was not big enough to make the matter sure, and they had decided to repeat the experiment when war intervened.

Meanwhile, the Einstein theory had gained its universal fame.

In 1921 Professor Miller decided to perform his 1914 experiment again, and this time to do it on the summit of Mount Wilson, Calif., in order to get as far as possible above the supposed "dragging" of the ether by the earth. He feared, also, some obscure magnetic disturbance arising from the steel framework of the original apparatus, and so made the new interferometer of concrete, with aluminum mountings. This instrument was set up on Mount Wilson, close to the building which houses the world's largest telescope, and was enclosed in a tiny shelter christened (Continued on page 104)



# Will America or England Win Race to Make Movies Talk?

## Remarkable Cameras Photograph Actors' Words

THE greatest question in the motion picture world today is whether or not the pictures of players in the movies should be given voices and made to speak their parts like actors on the stage. While many artists, motion picture experts and writers assert that the power of the silent drama will be damaged if its silence is destroyed, scientists in three countries have lately made such remarkable progress in photographing and reproducing voices on movie films that it seems certain the coming of speaking photo plays—whether we want them or not—cannot be long delayed. The most promising recently invented methods of making the movies talk are described in this article.



Above, Prof. J. T. Tykociner, a scientist of the University of Illinois, and at right his sensitive photoelectric cell that recreates a voice image into sound.

IS THE talking, singing movie soon to become more than a mere experiment? Will the speech and laughter of film heroes and heroines, now left to the imagination of audiences, soon echo through motion picture theaters with true realism, in exact accord with the movements and gesticulations of the actors' images on the screen?

While some experts in the motion picture industry are still arguing against the desirability of adding speech and song to silent pictures, a small army of scientists and inventors in practically every country of the globe are hard at work on ingenious schemes of adding more life to cinema films by giving the actors natural voices.

### Picture and Voice on One Film

One of the most promising solutions, in so far as immediate results are concerned, comes from the University of Illinois, where tests of the talking pictures of Prof. Joseph Tykocinski Tykociner, assistant professor of research in the engi-

neering experimental station, are reported to have met with marked success. His method of placing the image of a voice on the same celluloid movie film that carries the picture image, then reproducing the sound image into sound again, is not so revolutionary as are the refinements of the mechanisms by which he actually photographs the voice vibration by a beam of light, then conversely recreates by electricity the sound from the photographic image in amplified volume. Film samples produced by this method are reported not only to have produced the voice of the actor with a high degree of fidelity, but to have completely synchronized the voice and the action on the screen.

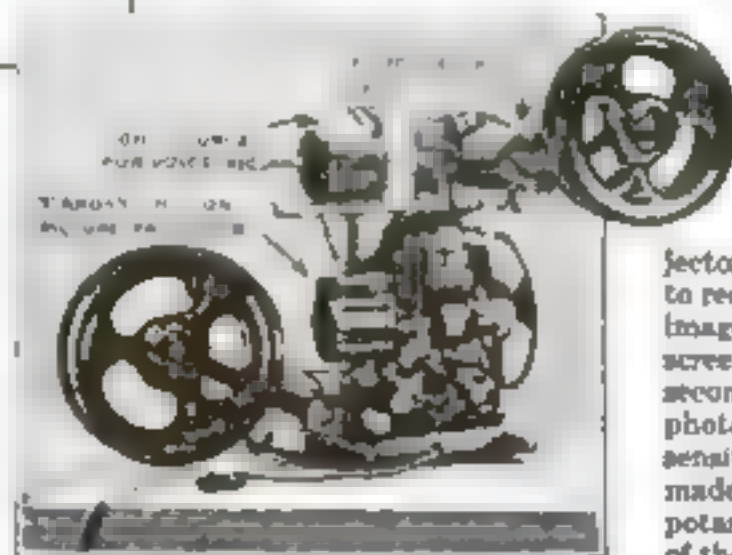
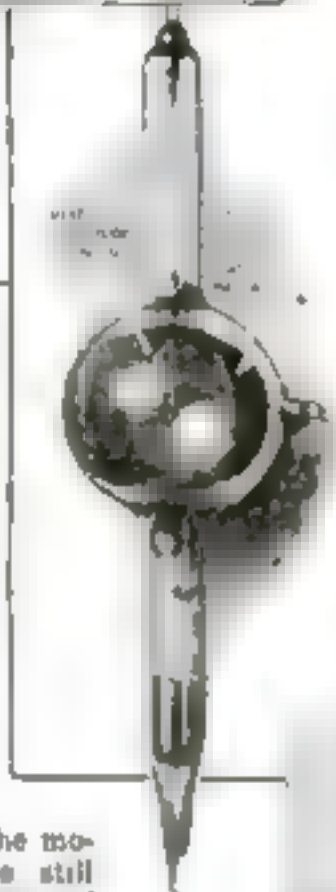
In the past, the difficulty of

obtaining this complete synchronization of voice and action has been one of the greatest stumbling blocks in the way of successful talking movies. Attempts of the actor to talk into recording phonographs after performing before the cinema camera, watching a reproduction of his image to guide his speech, have resulted in only imperfect approximations of synchronisms.

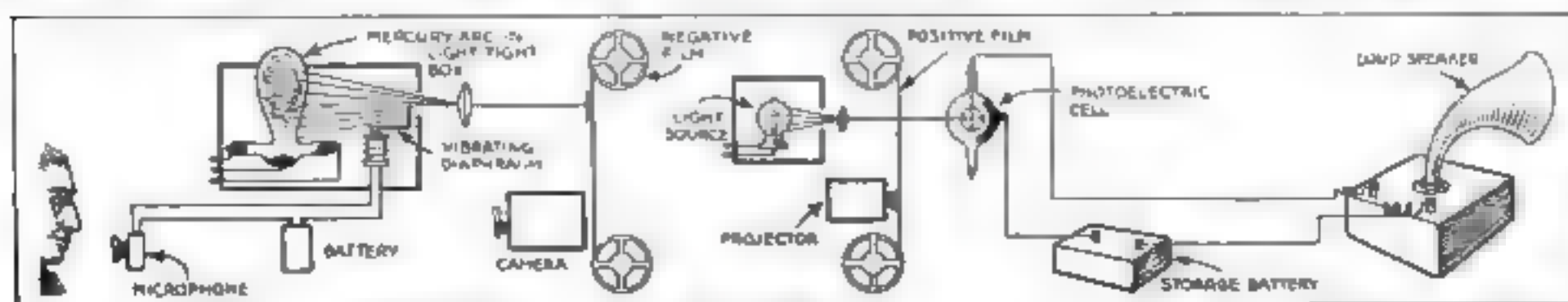
### Light Beam Records Sound

Professor Tykociner obtains his voice record by an attachment added to the ordinary cinema camera. This attachment comprises a powerful light source that throws a beam of light on to the film strip at the same time that a pictorial record is being made through the lenses. The intensity of this light beam is varied by a shutter operated by a diaphragm, which in turn moves in accordance with the flutterings of hidden microphones near the speaker-actor. As the intensity of the light beam varies, the sensitized film is likewise affected to a corresponding degree, and after development, this voice record appears as a narrow wavy band cross-marked by stripes of varying density.

After a positive is made from the negative, the positive can be run through any standard projector that is provided with an attachment to recreate the voice from the photographic image. The film picture is thrown on the screen in the customary manner, but a second ray of light focused through the photographic record of the voice strikes a sensitive photoelectric cell. This cell is made of a thin layer of caesium, rubidium, potassium or selenium deposited on one side of the glass wall of the gas filled bulb, and a plate or grid of wires suspended in the center. The deposited layer and the electrode are connected with a sensitive diaphragm through a battery. When



This projecting machine reproduces the voice record simultaneously with motion pictures, by a method made clear in diagram below, which shows recording and reproducing systems.





a beam of light strikes the light-sensitive metal film in the bulb, electrons that are set free travel in a stream to the electrode and allow a current to flow. Although the current that moves against this electron stream is small, of the order of one billionth of an ampere, the microphone is operated by amplifying the current flow by a series of vacuum tubes.

Since the current flow in the photoelectric cell will vary according to the variations in light intensity, the microphone will vibrate in strict agreement with the movements of the original microphone that stood before the speaker when the film was made.

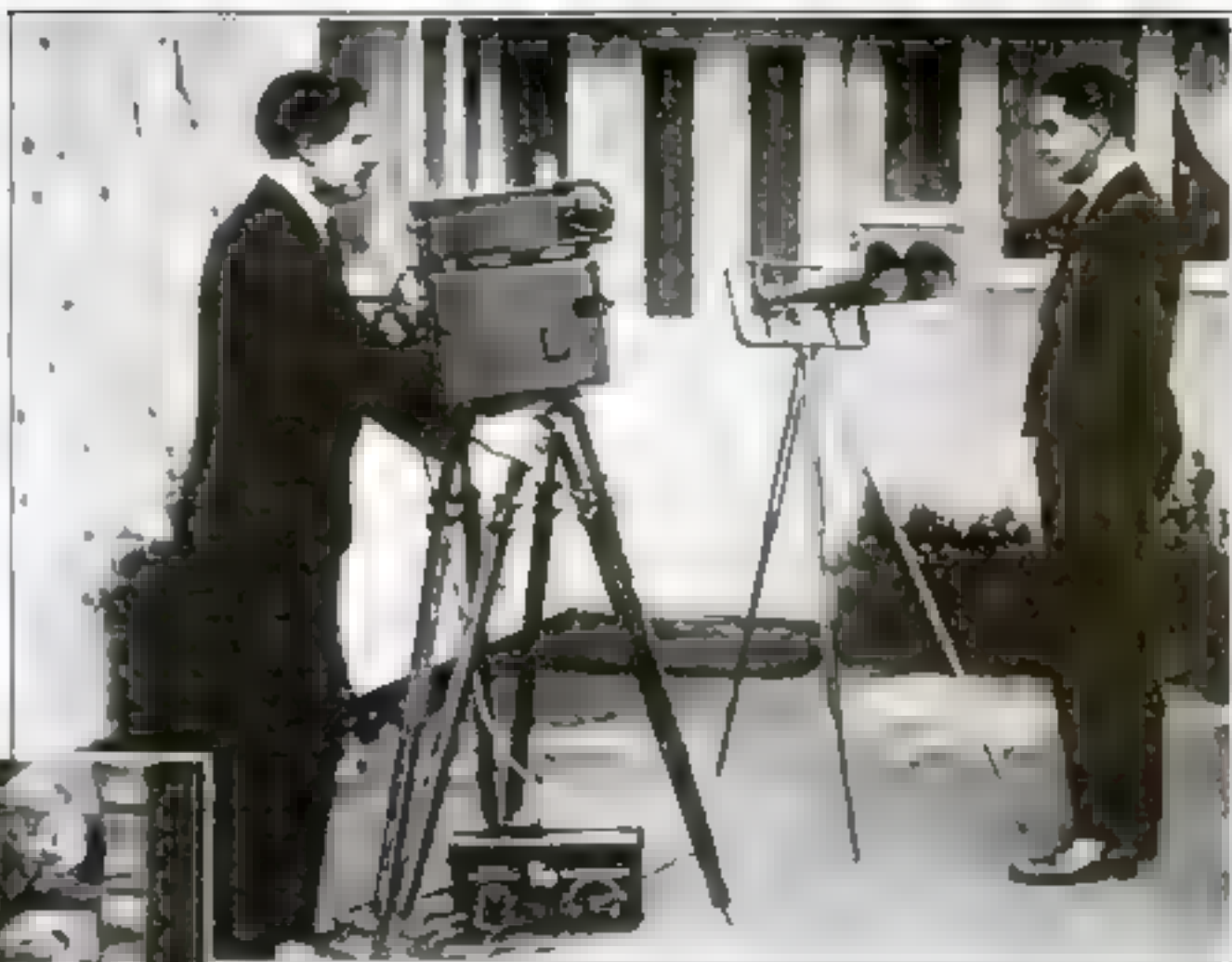
By having the voice record on the same film and exactly opposite the action image, synchronization, the lack of which has so conspicuously impeded the advance of talking motion pictures, is at all times assured. If a section of the film is damaged by carelessness or by fire, the removal of the action removes the corresponding voice image, and although the gap will be evident to the audience, the action and voice from the faulty point on will be in full synchronism.

### English Competitors

Another inventor—Professor A. O. Rankine, of England—working independently, has evolved a system of talking pictures following almost entirely the procedure of Professor Tykociner, except that Professor Rankine uses a light beam passing through a slit and a series of optical lenses to obtain the record of the voice on the film strip.

In England, also, Grindell Matthews has worked out a method of recording the voice of the cinema actor, in which a small mirror, oscillating in accord with the vibrations of the diaphragm of the microphone, prints its record on the celluloid film. Mr. Matthews uses separate recording devices for voice and picture, one above the other.

Two German inventors, Ernst Walter Ruehmer and R. Thirring, in a scheme for



### Twin Camera Records Voice with Pictures

**T**HIS is England's best bet in the race to develop a "talking movie" camera. Recently invented, by Grindell Matthews, the apparatus consists of two combined cameras, one of which records motion pictures, while the other makes a synchronous photographic record of the actor's voice. The voice is transmitted through two funnels to microphones and reproduced in the sound camera, above the picture camera, by means of a strong light reflected by a mirror oscillating in accord with vibrations of the microphone diaphragm and an interposed prism.

combining sound and action, photograph the sound waves by recording the fluctuations in the intensity of a ray of light under the influence of electromagnetic vibrations induced by the oscillations of a microphone diaphragm. These records are then reproduced at the same time and with the same speed as the picture images by utilizing one of the various forms of photoelectric cells.

The method of producing speaking movies by combining the phonograph and cinematograph—a method attempted by a number of experimenters with only partial success—is reported to have been developed to a high degree of perfection in France by Léon Gaumont. Heretofore the chief drawback to this method has been the extreme difficulty of keeping the two instruments "in step" that is, of making the sounds from the phonograph keep pace with the action in the screen picture.

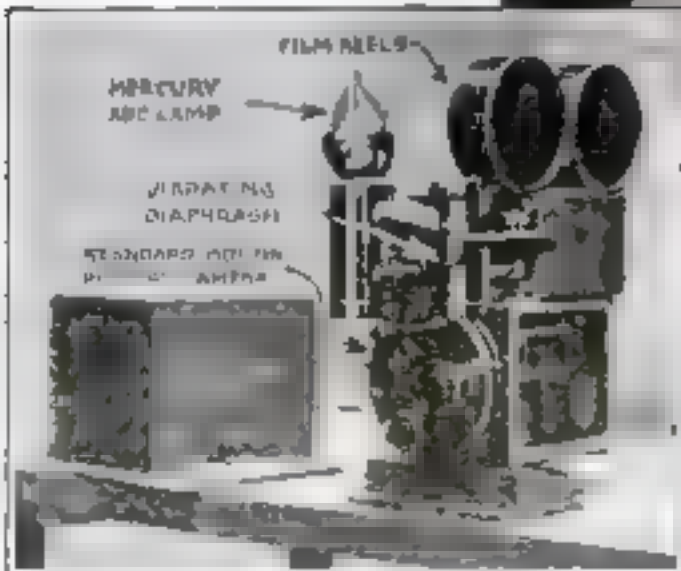
This difficulty Gaumont is said to have overcome successfully by means of improved synchronizing devices. These include a rheostat placed in a circuit common to the motors of both machines to secure equality of speed, and a small "booster" motor to remedy any lag or lead in the recording apparatus. For reproduction in the theater, an electric control automatically starts the cinematograph

projection at a given sound from the phonograph. Two talking machines are worked alternately to secure continuity; when the record of one is exhausted, the other comes into play. By this means the sound records are joined up, just as films are cemented, end to end.

### Unique Talking Movie Device Invented by De Forest

**W**HILE an intensified current effort to produce commercially practicable talking movies is narrowing down to a contest between scientists in America, England, and France, the announcement comes that Dr. Lee De Forest, inventor of the audion used in radio receiving, is prepared to enter the race with a remarkable device of his own, called the "phonofilm," which is to be demonstrated in America sometime in the Autumn.

Mr. De Forest's invention corresponds to those described on this page, in that the sound waves of the movie actor's voice are reproduced in the form of vibrations on the film but in other respects his apparatus is unique. Using standard motion picture camera and projector he has a basic invention that he calls the "photon," a glass tube about 1 1/2 inches long, which is fitted inside the camera, and which is said to develop under electrical stimulus a powerful violet light. The sound of a voice, picked up by sensitive microphones, is transmitted by high frequency current to the photon tube, whose violet light, modulated by the voice current, makes the sound wave that is photographed on the film.



Above, a strip of talking motion picture film and Professor Tykociner's "talking movie" camera with which the film was made. Note, on the right edge of the film, the voice record consisting of light bands produced by variations in a light beam in accord with vibrations of a diaphragm.





W. H. Driscoll, whose business is installing heating plants in skyscrapers like the Woolworth Building, and whose hobby is the heating of small homes

# How You Can Burn 30% Less Coal and Still Keep Warm This Winter.

*Use Scientists' Astonishing Discoveries about Your Heating Plant to Thwart Coming Coal Famine*

By W. H. Driscoll

Director of the American Society of Heating Engineers

**T**HERE is apparently a grave fuel emergency approaching. I believe that it will sharply awaken the average American to the costly inefficiency of his domestic heating plant.

The homes in which our families live 24 hours a day certainly deserve more attention from heating engineers than the office buildings in which we spend only eight hours a day. Yet homes have been neglected, while the heating of office buildings has become a science. Personally, however, I have derived more genuine pleasure from installing hygienic and economical heating systems in little bungalows than from my biggest jobs.

So speaks one of America's most distinguished heating engineers, among whose "biggest jobs" are installations in the two largest skyscrapers—the Woolworth and Equitable buildings of

New York City—not to mention the Continental and Commercial Bank Building of Chicago, and the General Motors Building of Detroit. He is W. H. Driscoll, a director of the Society of Heating and Ventilating Engineers, and vice president of the Thompson-Starrett Co.

**B**ECAUSE scientific heating of the small house is his hobby, Mr. Driscoll has consented to give readers of POPULAR SCIENCE MONTHLY in the accompanying article helpful advice for fuel economy.

His article is not intended as a scientific treatise. The figures given are in some cases simply approximations or estimates, for comparative purposes. Mr. Driscoll has merely endeavored to point out how much may be done to increase the efficiency of the domestic heating plant.

**I**F YOU could be assured that you could save a considerable part of your fuel bill for the coming winter by making a few simple changes in your heating plant and your house, would you try it? Accept, then, my assurance that the average householder can make such a saving, or, state the case negatively, of the 260,000,000 more tons of coal burned annually in this country for heating homes, at least 10 per cent is lost in preventable waste.

The best types of house heating plants have a thermal efficiency of about 80 per cent. That is, they deliver in heat to the rooms about 80 per cent of the fuel value of the coal burned in them. But most of the millions of stoves, furnaces, and boilers operated in private homes show a much lower efficiency, probably half as great. In some cases, the heat leaks into the cellar instead of being carried to the rooms upstairs. Sometimes the fault is in bad design of furnace, boiler, or chimney, more often it is in faulty installation. Sometimes the fault cannot be easily remedied, but there is hardly a house heating plant in existence that cannot be improved by any man possessing ingenuity and some mechanical skill.

## A Second Coal Famine

An industrial upheaval has made probable a fuel shortage this winter. Once before—during the war we faced such a fuel situation, and that experience awakened as never before scientific interest in the problem of conserving fuel in the home. The conclusions drawn from a great deal of resultant research work are just becoming available to engineering, but in general the heating in-

dustry has not hitherto passed them along to the

### SAVING COAL

THREE DEVICES FOR GETTING MORE HEAT WITH LESS FUEL

are of the most economical construction, costing \$6000 or less.

These homes nearly always are heated by stoves or warm air furnaces simply because such heating plants are cheapest. There are some 10,000,000 homes in the country that depend on stoves for heat. And probably an equal number use warm air furnaces. An authority on steam, water, and vapor heating systems estimates that there are about 3,000,000 boilers in private homes used for these types of heating.

In recent years the warm air furnace has apparently been losing in popularity. This opinion is wide-spread that it is obsolete. Nothing could be further from the fact. The trend of recent investigation seems to indicate that the coal heating plant for the small home, when it is properly developed, probably will be of this type, for it is more readily adapted to simple improvements that will cut fuel bills and add to comfort.

Of the two important research studies on the problem of house heating set in motion during the wartime fuel shortage, one is supported by the American Society of Heating and Ventilating Engineers in conjunction with the United States

### WASTING COAL

THE WRONG WAY TO RUN A FURNACE



Faults that cause fuel waste in domestic hot air heating plants—the commonest type—are made clear in this diagram. Inset shows inexpensive improvements that will make the system more efficient.



Bureau of Mines at Pittsburgh. The second is conducted by the University of Illinois, with the support of the National Warm Air Heating and Ventilating Association.

The principal tests at the Illinois University laboratory have been conducted in a novel skeleton house, erected within the great mechanical engineering laboratories of the university. Various types of furnaces are installed under the skeleton house and the rooms are inclosed by various types of walls or partitions as desired.

Long Accepted Theories Exploded

One of the important results of these investigations has been to explode some of the theories held since time immemorial. For instance, one of the first things usually suggested to the man who seeks relief from a poor furnace, is to cover all exposed warm air ducts with asbestos paper. Common sense would seem to indicate that this is the right thing to do, but repeated tests have shown unmistakably that the usual single coating of asbestos paper actually increases the heat radiation from that pipe as much as one third!

This series of experiments indicates a general rule for insulation against heat or cold that the amateur heating engineer will find constantly useful. When insulating against low temperatures (warm air pipes, the heat or cold of outdoors, etc.), the best insulation is closed air spaces; but in insulating against high temperatures (furnace walls, steam pipes, etc.), use a solid insulator such as asbestos or magnesia.

The proper insulation of a house against outside weather is too often neglected by the builder of small houses. It is hardly an exaggeration to state that fully 40 per cent of the heat losses in the average house can be attributed to this neglect—the leakage of air through walls and around windows and doors. But while the householder cannot very well tear down a wall to correct these defects, he can at least take the following precautions.

See to it that there are no holes at the top or bottom of the walls by which air can circulate from the cellar to the attic. If there are such holes, cover them with building paper or wallboard. It is a common thing to find that the insulation of a house has been applied effectively except to the ceilings of the top floor, where only one thickness of plaster separates a warm room from a cold attic. In this case, tack building paper over the tops of the rafters to inclose air spaces over the ceiling. Over-

hanging rooms, with no cellar beneath and only one thickness of boards on the floor, are often fatal to the operation of the heating plant.



Health in the Home

HEATING engineers are unanimous in the statement that two instruments—a thermometer and a hygrometer—are essential in every home. The hygrometer (for measuring relative humidity—one type shown at right) consists of two thermometers, one with a dry bulb, the other with bulb inclosed in a water-soaked wick. The difference in degrees registered by the two thermometers, when compared with an accompanying scale, indicates percentage of moisture in the air.

The picture above shows how the hygrometer should be installed near the floor when there are small children in the house. If a healthfully humid temperature were shown by an instrument placed far above a child's head, the temperature and relative humidity at about the height of the child would be too low.

Storm windows and doors (especially on the north and west sides of the house) and weather stripping will frequently save their cost in fuel in a single season and are among the ordinary precautions that ought to be taken.

The most reliable indication that a heating plant is wasting coal is a warm cellar. Sometimes the cause is defective construction of the furnace itself and there is little to be done about it, but more often the blame for a hot cellar lies in poor workmanship and careless installation.

The usual cause of a too-warm cellar from a warm air furnace is poor circulation of air within the furnace, which in turn may be due to two things—wrong layout of the warm air pipes overhead or, more likely, wrong construction of the cold air duct bringing air to the furnace.

Intake Pipe Causes Trouble

Nearly every furnace user has found it difficult to get an even distribution of warm air to the registers. Sometimes nearly all the heat will issue from one register, while other registers will be cold or may even draw in cold air. This condition is almost always due to the small size of the cold intake pipe, and if it is remedied, many of the common furnace troubles will be eliminated. The intake pipe ought to have an area in cross section practically equal to the combined area of all of the warm air pipes. It is safe to say that scarcely one furnace installation in a thousand meets this condition.

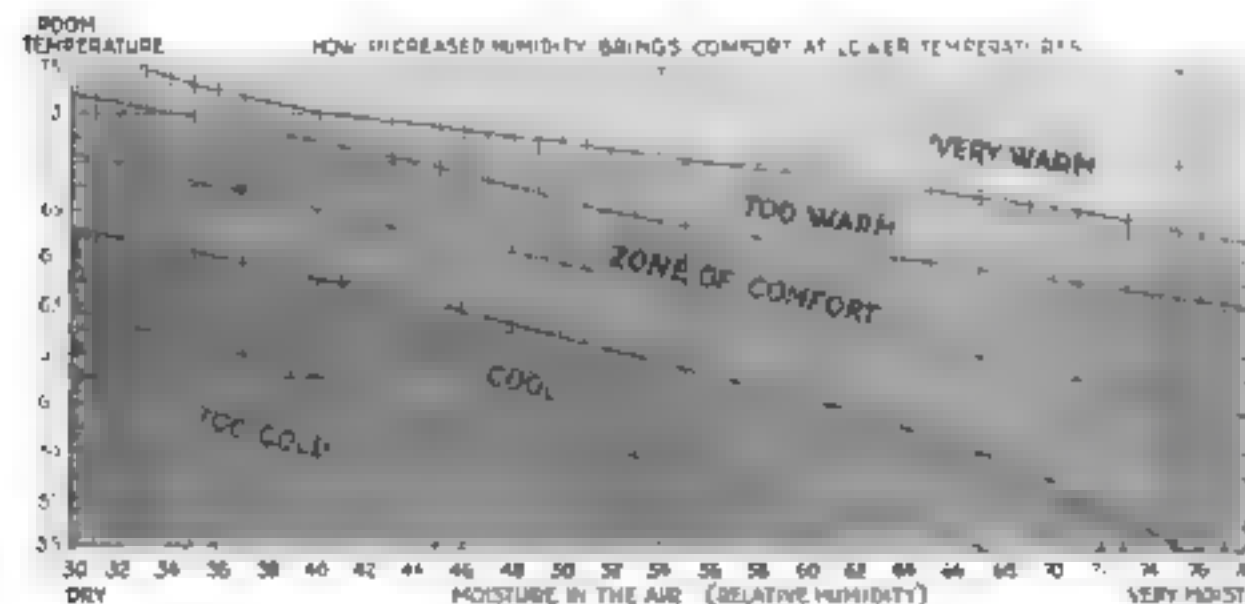
First aid for most furnace troubles consists in enlarging the cold air duct. In doing this, we ought to avoid the old, old mistake of taking all the cold air from outdoors. It is a mistaken idea that it is unhealthful to recirculate the air in the house. One investigator estimates that 90,000 cubic feet of air an hour is needed to heat the average house of eight rooms and bath. If 10 persons constantly occupied this building, their maximum requirement for fresh air would be 18,000 cubic feet an hour. As a matter of fact, the infiltration of air about windows and doors would bring in about that quantity of fresh air and it is simply a waste of fuel to heat the total quantity of air passing through the furnace from the outside temperature, instead of reheating the already warmed air in the rooms.

In a church where two furnaces were used, one taking its fresh air from the outside and the other from inside the structure, it was found in careful tests that the second furnace gave exactly twice the heat of the first in cold weather on the same amount of fuel.

Outside or Inside Inlets

It is a good plan, when remodeling the air supply duct, to provide both outside and inside inlets with a leaf valve at the junction of the two pipes so that all or any part of the air supply may be taken either from outside or inside the house. The outside air supply can then be used in mild weather, or whenever wanted.

If the furnace works all right in mild weather, but fails in extremely cold weather, relief may be obtained by placing a small electric fan in the inlet duct to blow air to the furnace and thus cause a brisker circulation throughout the whole system. The fan would be used only in warming up the



THIS chart shows how the temperature of the home may be lowered with no loss in comfort if the relative humidity of the air is increased, thus effecting an important saving in fuel.

Extensive tests have demonstrated that perfect comfort is possible at a temperature of 63 degrees if the humidity is sufficiently maintained. Relative humidity can be measured by a hygrometer



**A**IR need never be heated above 65 degrees for comfort. Anything above that point represents waste and extravagance. It simply runs up a big coal bill and opens various doors

to the coming of the doctor. The onset of coughs in winter is almost a sure sign of extravagance."—Dr. William Brady, noted American authority on health in the home.

house in the morning or in extremely cold weather. It is a matter of record that an ordinary electric fan installed in this way will double or triple the capacity of the heating system.

When a fan or blower is used, however, all air must be taken from inside the house, that is, recirculated. The fan causes a much larger movement of air through the furnace and as a result the registers deliver a large volume of slightly heated air rather than a small volume of highly heated air (a desirable thing). If air is taken from outside, it might even chill the house rather than warm it.

### Thermostatic Control

Another very great improvement in the ordinary furnace installation is the addition of one of the now familiar automatic thermostatic control systems for the dampers. This apparatus cannot be made at home very well, but a number of standard makes are available, some of which automatically open the drafts in the morning at a predetermined hour. In fact, such controls literally do everything but shovel on the coal and take out the ashes. The instruments range in price from about \$10 to more than \$100, but will soon save their cost in coal. They entirely eliminate such accidents as letting the fire get too low before the dampers are turned, or forgetting that the dampers are open until the house is too warm—both fuel-wasting operations.

Steam, hot water, and vapor systems cannot be so easily improved by "home-made" methods as can warm air furnace systems, but there are a number of patent specialties that will materially increase their efficiency. Automatic control for the steam system is much simpler than for any of the others. A temperature regulator consisting of a diaphragm actuating a lever that is connected by rods or chains with the dampers will automatically maintain whatever steam pressure may be desired.

Economy of installation often influences the selection of cheap venting valves on the radiators. These soon become faulty in operation, with the result that sputtering, leaky valves or cold radiators are common experiences. Such conditions may be remedied by replacing these with higher grade and, in the end, more economical valves.

The hot water system apparently offers

little opportunity for improvement aside from the possibility of improved control of the dampers. Contrary to the common notion, the hot water system does not improve the humidity conditions within the home. As a matter of fact, if the humidity conditions are to be improved, water pans or other separate method must be provided to introduce additional moisture.

The matter of humidity is of prime importance in domestic heating and it is the

this principle reflects directly on the coal pile, for a saving of only a few degrees in heat means a large saving in fuel. Experiments with the classrooms at the University of Illinois, showed a saving of 17 per cent in fuel consumption in a temperature reduction from 75 degrees to 70 degrees. As a matter of fact, some health authorities urge a house temperature of 68 degrees, and it has been demonstrated in extensive tests that it is possible to be perfectly comfortable

at 63 degrees if the humidity of the air is sufficiently maintained.

Humidity, it ought to be explained, is a relative term, and is expressed in percentage. Air absorbs water like a sponge, up to a certain point—the point of saturation—at which it will hold no more. When the humidity is 60 per cent, the air contains half of the total amount of water it can hold. This ability to hold water increases rapidly as temperature rises. For instance, at zero air is saturated when it contains one half grain of water a cubic foot. This same air heated to 70 degrees would have a humidity of only 6 per cent, whereas more than four grains of water a cubic foot at 70 degrees are necessary for bodily comfort.

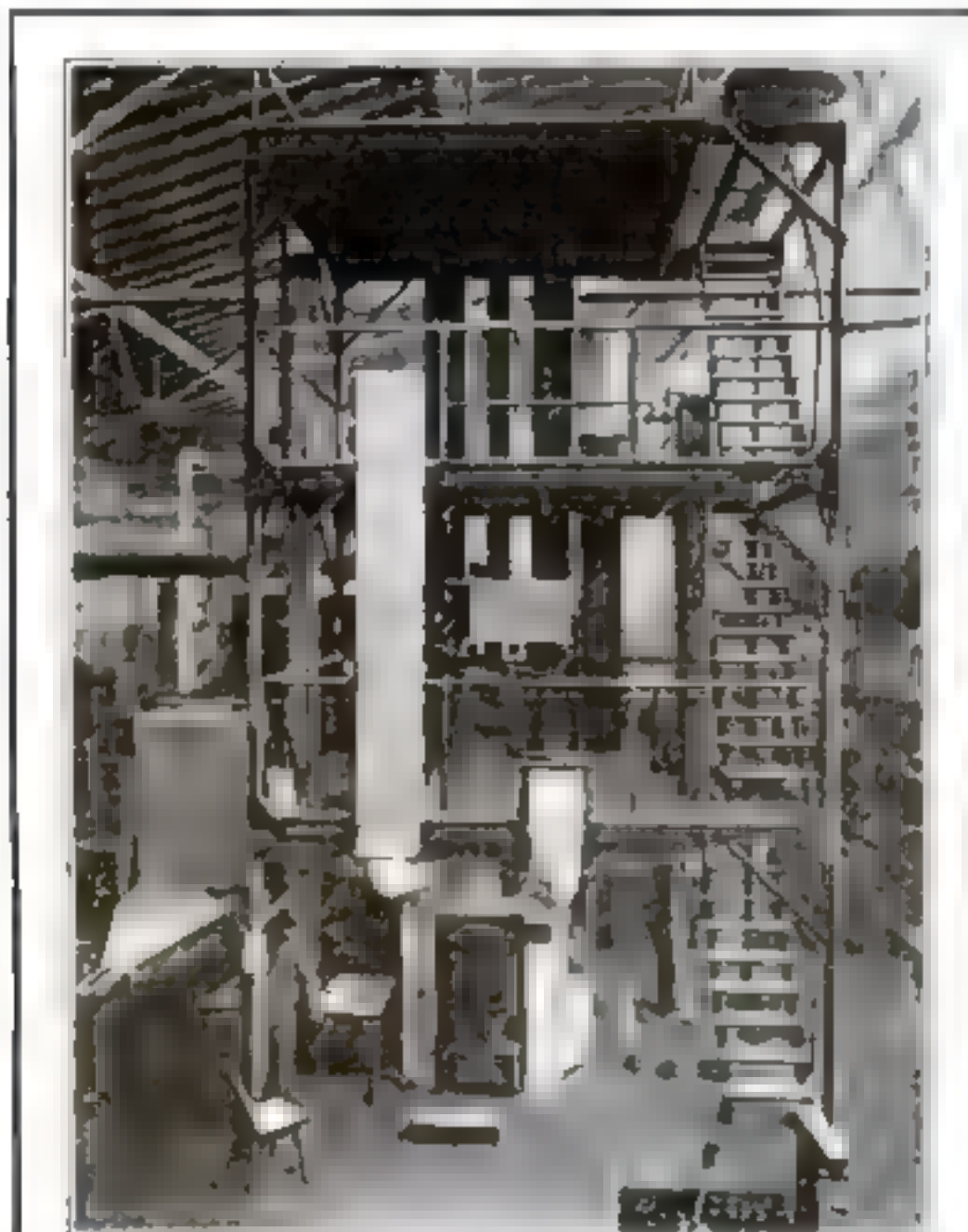
### Home a Desert

It will surprise many people to learn that the average house in winter is actually dryer than the Sahara Desert. The average humidity of the great desert is about 80 per cent. During the month of February, 1919, the technical instructors of one of the high schools in Newark, N. J., kept account of the humidity within the classrooms and outside. The average outside temperature was 38 degrees and the average humidity 61 per cent. Heating this air to 70 degrees (there was no provision for humidifying the air within the building) reduced the humidity to an average of 16 per cent, just half that of the Sahara Desert. On some days the humidity in the classrooms was as low as 8 per cent, and

only on two days did it reach as high a mark as the Sahara's average. Further investigations showed that this condition had a very bad effect on the comfort, ability for work, and the behavior of the pupils.

Investigations have conclusively demonstrated that the increase in sickness that always occurs in winter is due, not so much to a lack of ventilation, as to a lack of humidity in

(Continued on page 102)



### Where Revolutionary Heating Facts Have Been Learned

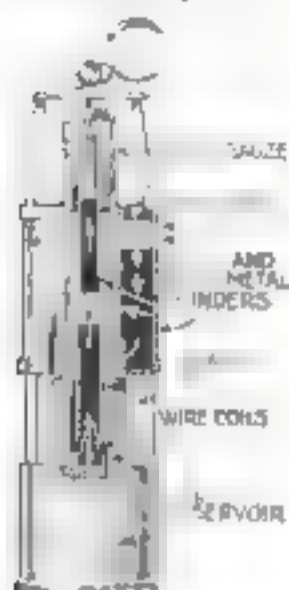
**M**ANY common but fuel-wasting theories about house heating—such as the idea that it is unhealthy to reheat and recirculate the already warmed air in the home, or that a coating of asbestos paper will prevent heat radiation from warm air pipes—have been exploded by recent tests in this remarkable "skeleton house," erected in the great mechanical engineering laboratories of the University of Illinois. For the tests, various types of furnaces are installed beneath the "house," while the rooms are inclosed by different kinds of walls and partitions.

most thoroughly neglected of all the questions involved. The human body, like a house, is constantly losing heat, and most of the loss is due to evaporation of body moisture. When the air is humid, evaporation is slower, hence the loss of body heat is less than when the air is dry; and therefore we can be comfortable in the heated house at comparatively low temperatures if the air is sufficiently humid. Application of



## "Singing Lamps" to Warn Miners of Danger

**SAFETY** lamps that sing when danger from "firedamp" threatens have been devised for the use of miners. The principle employed is that of the "singing flame."



How the lamp is designed

Scientists have known for centuries that a hot flame burning in a narrow tube under certain conditions will set up vibrations and produce audible sounds.

The lamp consists of a burner fitted with a small coil of wire and inclosed in a glass tube, which in turn is placed within a metal case. Air supporting the combustion enters near the top of the case, passes downward and then up

by the burning wick. Adjustment of the flame will make it sing when the percentage of fire damp, or methane, reaches a dangerous proportion. In practice this has been found to be at two per cent.



When the percentage of fire damp reaches the danger point, the safety lamp "sings"

## Signboard with Wings Revolves in Breeze

**ANIMATED** billboards operated by wind gusts have made a decided hit with merchants near Dayton, Ohio, the home of Mr. C. L. Correll, the inventor.

The sign is mounted on a structural steel tripod and has four wings, five by 10 feet in size, carrying advertising matter on both sides. All rotating parts are suspended from ball bearings to make the sign responsive to slight wind currents.



Four rotating wings, mounted on a tripod, carry advertisements

## One Man Pulls Stump by Hand



Mounted on a wheelbarrow the hand winch is anchored to one stump, while cables are attached to the stump to be pulled. The operator turns the crank of the winch

**STUMPS** can be pulled by hand with a light, portable machine recently invented by John Martinson, of Wrenshall, Minn.

By a very simple arrangement of gears, shafts, and a double block and tackle, the strength of one operator is multiplied to that of 672 men. A wire cable slipped around the top of the stump yanks it out by the roots.

The essential part of the device is a light "wheelbarrow" carrying a hand winch operated by a crank. A strap is

passed around the top of the stump to be removed, the tackle hooked on and set taut, and the portable winch anchored to another stump by a strap passed around the root. The operator then turns the handle of the winch until the first stump is hauled from the soil.

An adjustable gear ratio makes this machine adaptable to all sizes of trees. One farmer pulled 84 stumps in three hours, without assistance, in a contest at Deer River, Minn.



## Two-Foot Fish Rod Casts Line 150 Feet

**CASTS** of 150 feet with a rod only 23 inches long are said to be common among fishermen who use a new rod and reel recently developed in Dayton, Ohio.

The reel is made of aluminum with brass bearings. A counterbalance on the reel makes the line run freely, while a spring steel friction device permits the fisherman to adjust the tension.

The rubberoid handle, which is hollow, carries a rod setting pin. This pin, when pushed into the ground or stuck in the carlock of a boat, supplies a support for the rod and reel for still fishing.

## Scientist Asserts Will Power Can Be Weighed

**"POWER** of will" is visibly demonstrated by a strange "will board," according to its owner, Mr. Hereward Carrington, of the American Psychical Institute and Laboratory.

The will board, originally devised by Dr. Sidney Altrutz, of Sweden, is a flat piece of wood pivoted unequally upon knife edges and connected at its longer end with a delicate spring scale by a flexible cord. When adjusted for the test, the weight of the board at the longer end is five ounces.

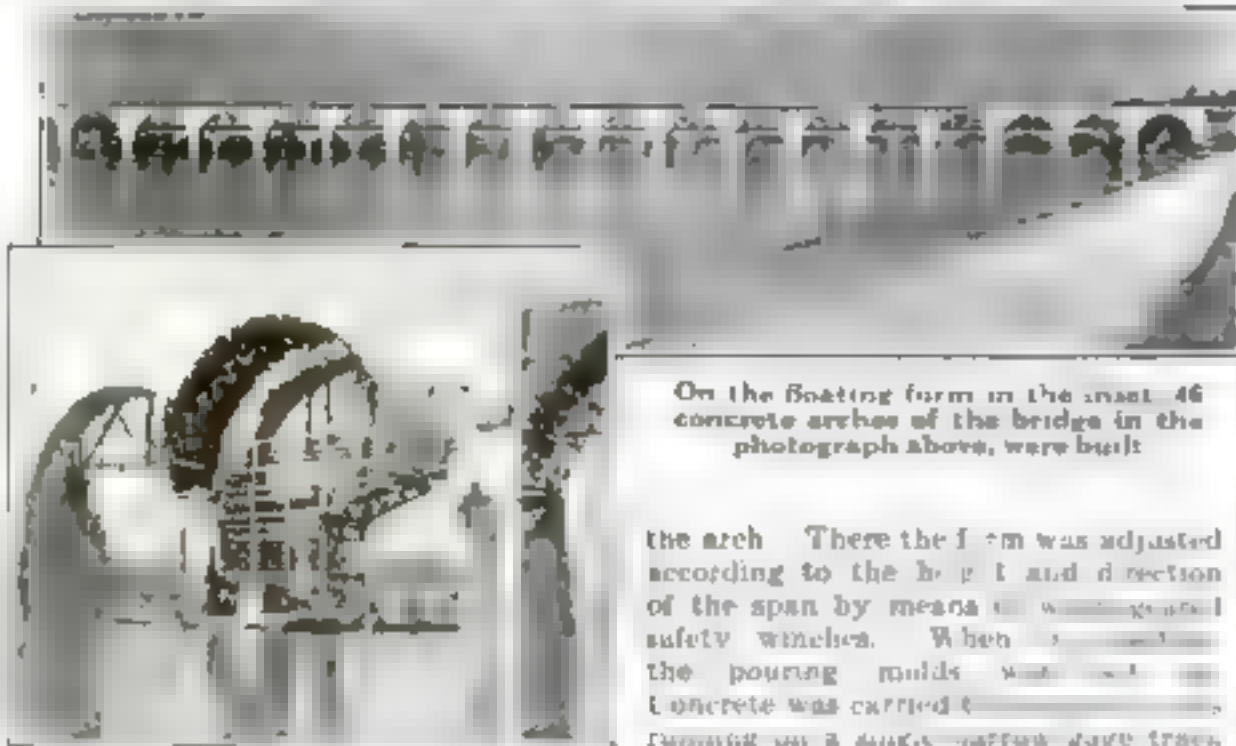
When any pressure is placed upon the short end, the scale reading will be less, of course. Yet when the subject is told to place the tips of his fingers lightly on this end and "will" that the longer end be depressed, the reading of the scale can sometimes be increased beyond the normal five ounces, it is said, thereby proving the subject's "power."



Depression of the long end of the board denotes strong will power



## Bridge Arches Built with Floating Form



On the floating form in the inset, 46 concrete arches of the bridge in the photograph above, were built.

**BY USING** a single, floating foundation form in the construction of 92 reinforced concrete arches for a new railroad bridge across the Susquehanna River at Harrisburg, Pa., the Philadelphia & Reading Railway recently solved the problem of supplanting an old 46-span steel bridge, placing the new bridge on the same piers, without interrupting traffic across the river.

The movable form for the concrete arches, with a span of 66 feet, had a width of only 13 feet nine inches, half the width of the completed bridge. It was supported by a steel traveler mounted on a barge, which was towed to the position for the construction of

the arch. There the form was adjusted according to the height and direction of the span by means of winches and safety winches. When the pouring molds were set, concrete was carried

forming was a single narrow-gauge track supported by a cantilevered structure bolted to the upper part of the steel bridge. A derrick boat handled the molds and reinforcing steel.

In this manner, while one half of the new concrete bridge was being built, traffic was handled without interruption over the single track on the old structure.

As soon as the first half of the new bridge was completed, the one available track was shifted to it, while the other half was built.

Since there are 46 arches in the bridge, and each arch is made in two sections, it was necessary to set up the movable form 92 times in completing the bridge.

## Disk Machine Cuts Turf Borders Evenly

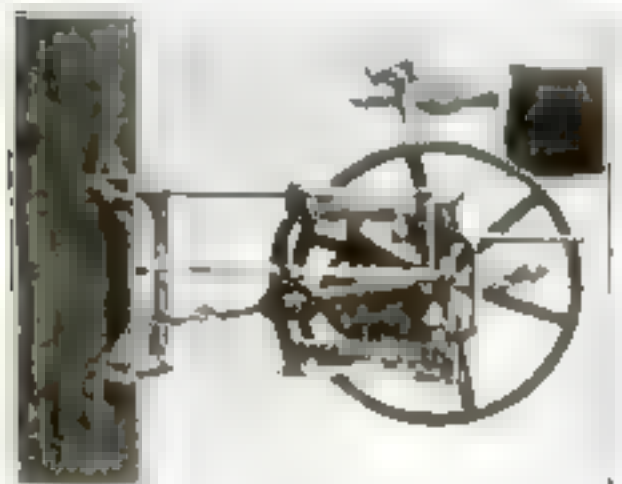
**A** LAWN edging machine for cutting turf bordering on paths and driveways has been developed by a Cleveland manufacturer. The machine does the work formerly performed by a spade and guide line, but cuts more evenly.

The edger is driven by a single tractor wheel that runs along on the grass surface. This wheel, acting through gears, rotates small steel cutting disks at 3000 revolutions a minute. So high is the speed that the disks readily cut through twigs up to one quarter of an inch in diameter.

The disks are made self-sharpening by setting them at an angle.



Small cutting disks are rapidly rotated by a single tractor wheel.



## Mortising Machine Saves Carpenter's Time

**A** NEW portable mortising machine will cut any kind of a mortise in a few minutes, saving about 90 per cent of the time formerly required in this work. It is particularly designed for cutting door-lock mortises.

After the machine is clamped to the work, the rotation of the handle spins a revolving cutter back and forth and at the same time advances it as the slot deepens. The cutting tool is similar in form to an ordinary auger bit, but without the screw point.

The bottom of the tool is perfectly flat and its spiral edges, as well as the bottom edges, are sharpened. Various sizes of bits are supplied for different sizes of holes.

**TAPE** measures, rolled into bolts of German cloth, now tell sawmen at a glance the measure of cloth remaining in the bolt.

## Ultra Violet Rays Kill Anthrax Germs

**A**N APPARATUS that makes possible the destruction of germs of anthrax and other dangerous diseases contained in bales of infected wool or hides, without opening the bales or separating their contents, has recently been perfected by Dr. Alfred Dinsley and Capt. A. O. Pulman, of London, England.

The economic importance of the invention is the fact that it will greatly reduce the cost of disinfecting imported wool or hides that heretofore has amounted to about three cents a pound. With this process, which instead of formaldehyde uses the germ destroying power of ultra violet light and certain invisible rays of even greater effectiveness, the cost is reduced to not more than half a cent a pound.

Most of the infected wool comes from East India and Persia, where anthrax is prevalent among cattle. The germs resist practically all methods of disinfection that do not, at the same time, cause a deterioration of the wool. Formaldehyde proved effective, but its employment made

it necessary to unpack every bale, wash and scour the contents, and then repack the bale.

During the war, Doctor Dinsley experimented extensively with ultra violet and infra red rays, although not with the object of ascertaining their potential germ killing power. The remarkable penetration of the ultra violet rays suggested the possibility of employing these and other invisible rays for disinfecting. After several years of experimenting, Doctor Dinsley, assisted by Captain Pulman, evolved an apparatus in which ultra violet rays are produced by a mercury vapor tube.



Ultra-violet rays, produced by a mercury vapor tube, penetrate infected wool, destroying disease germs.



# Coastal Motor Boat Must Dodge Own Torpedoes

**I**N RECENT tests on the Thames River, England, armored coastal motor boats destined for the United States navy, clipped off a two hours' run at a speed of 45 miles an hour.

The miniature vessels are only 45 feet in length and eight feet six inches in beam. Each is driven by a 12-cylinder 275-horsepower gas engine, which in turn is started by a small 2½-horsepower auxiliary engine. Equipment for two depth charges and two 18-inch torpedoes is included as part of the armament.

The hull is constructed of two-ply mahogany with caissons between the layers to insure waterproof construction. In general, the hull design follows that of hydroplanes with a step beneath for lifting the bow out of water. Thus the draft at full speed is



From the stern of the little speed craft, torpedoes are discharged along the two troughs shown in the above photograph.

only a few inches. For carrying and releasing the two torpedoes, two troughs, formed of mahogany boards, are provided in the after portion of the boat. Along both

be used for mine laying, the mines are carried in the torpedo troughs. Sling plates are provided for lifting the craft out of water and carrying it aboard a mother ship.

sides of the troughs are oak runners faced with strips of manganese bronze, and the torpedoes, which lie in the troughs, are fitted with angle brackets that rest on the runners.

One or both torpedoes are discharged over the stern while the boat is traveling full speed in the direction of the objective. Since the torpedo travels in the same direction, the course of the boat is altered as soon as the deadly missile is launched.

The torpedo is aimed by bringing the pointer of a director gear, the stem of the boat, and the objective in line, and is discharged by the usual torpedo tube.

When the boat is to



## Cider Barrel Becomes a Talking Machine

**S**OMETHING strictly new in musical instruments has been evolved by William T. Weinschank, of Chicago, who converted a cider barrel into an attractive phonograph at a cost of only \$11.75.

After thoroughly cleaning the barrel, Mr. Weinschank cut double doors in the top side with a keyhole saw and swung the doors on hinges. A second hand spring motor and tone arm suspended from the inside of the barrel completed the work. The crank protruded from one end.

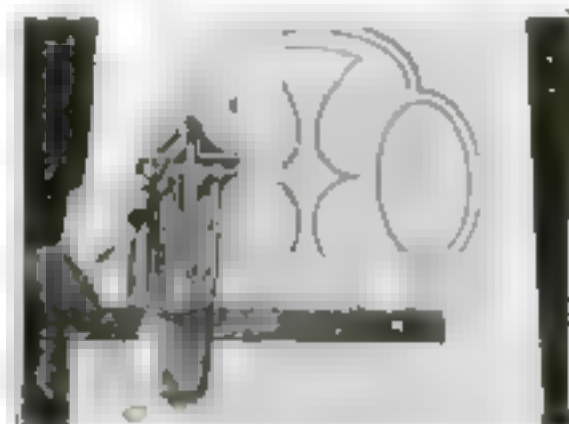
To give the talking machine a finish, the barrel was placed on a special support into which the circular heads fitted, and, as a final realistic touch, Mr. Weinschank added a spigot.

ONLY 30 per cent of the wood in a forest reaches the form of seasoned, unplanned lumber, government reports show.

## Draftsman's Instrument Will Draw Ellipse

**B**ASED on the theory of the ellipse—that the two axes have a definite relation to each other throughout the path of the curve—an instrument has been devised for draftsmen that readily draws ellipses of any size from one by two inches to 11 by 15. The geometrical figures can be drawn in any position with one circular motion.

The entire instrument, which is made for attachment to the regulation T-square, is 12 inches long, two inches high, and three inches wide.



Designing of intricate patterns is simplified by this instrument attached to T-square.

## National Kilograms Marvels of Accuracy

**A**T THE Bureau of Standards in Washington, D. C., are two small cylinders of whitish metal, insignificant in appearance, yet of tremendous importance to the scientific and technical world. They are the two national kilograms on which scientific weighing in the metric system is based. They stand just an inch and a half high, and their diameter is the same as their height.

These two chunks of metal, preserved under glass covers in a vault, have recently been used to verify the precision working standards in use at the Bureau for many years. They have also been checked by comparing them with each other. The results are most satisfactory.

The comparisons of the working standards with the

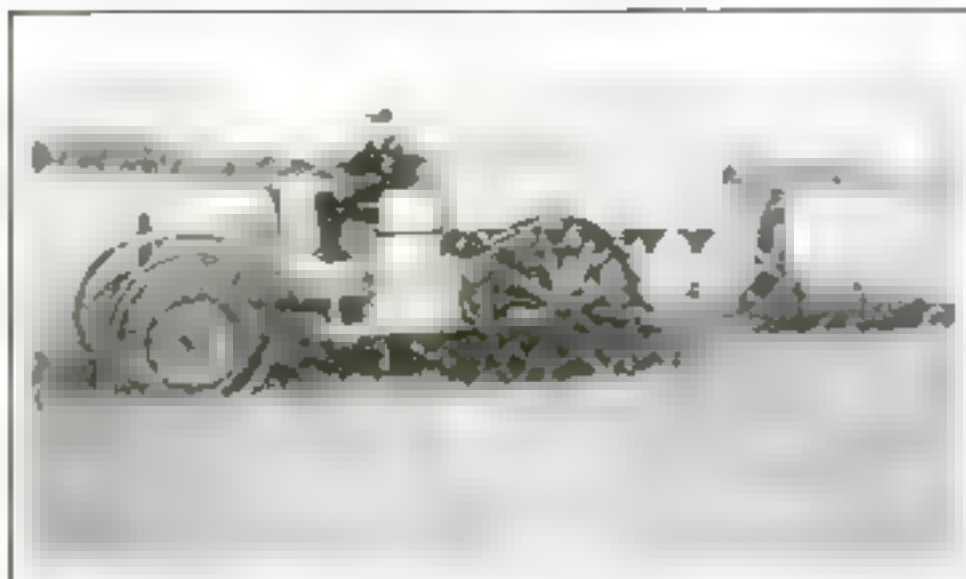
national standards were made with an accuracy corresponding to one part in 100,000,000. In other words, if one of these kilograms were regarded as being owned equally by every one in the United States, the removal of the share of one person from the whole could be detected. The agreement between the two national standard kilograms was even closer than this. On comparing the weighings, the final results checked out exactly to the last figure to which the computations were carried.



Each of the two national standard kilograms is protected by double glass covers, as shown above.



## Quick Change of Wheels Converts Truck into Tractor



For work in the field, the truck wheels are replaced by ground gripping tractor wheels of large diameter



On the road, the truck rides on pneumatic tires, with the tractor wheels slung at the sides

**T**HE amphibian plane now has its rival in a combination truck and tractor recently developed in France. Like the land-and-water plane, it carries two sets of running gear, one for each class of work.

For road travel, ordinary pneumatic tires are used. But when the machine reaches a field to be plowed, the rear wheels are replaced by ground gripping tractor wheels and the front wheels are supplied with rims of larger diameter. The tractor wheels are

driven by means of a link belt from gears on the rear axle.

In highway travel the machine with its 18 horsepower, four cylinder engine, can make 19 miles an hour. As a tractor its speed is reduced to about six miles.

### Pushbutton Trips Save Fingers of Workmen

**P**USHBUTTON tripping devices that require both hands for operation constitute one of the safety measures in the stamp press department of a Detroit automobile manufactory.

Since the pushbuttons are separated a distance of one foot and require both hands to actuate them, it is impossible for the heavy stamp to descend until the workman's fingers are out of the way. The same degree of safety is attained in machinery attended by two or more men by providing two pushbuttons for each workman.

In addition to the reduction in accidents through the use of these controls, the fatigue of foot tripping mechanisms is obviated.



Until the workman pushes both buttons, the heavy stamp cannot descend



### Stableboy Turns Crank to Curry the Horses

**D**ISSATISFIED with the old method of currying horses by hand, a French mechanic has invented a revolving brush that does the same work quicker and better.

A cylindrical brush with stiff bristles is equipped with a shaft that fits into a hand driven device similar to the common breast drill. A crank with a wide sweep gears up the speed of the revolving brush. To operate the device, the stableboy places the support of the curry brush against his chest, grasps the shank of the brush in his left hand and turns the crank with his right.

### This Small Movie Machine Uses Flashlight

**M**INIATURE motion-picture machines that use ordinary flashlights as the light source and produce sufficient illumination to exhibit pictures in the daytime have been developed for home entertainment and commercial purposes.

The flashlight rests on a base containing the intermittent mechanism of the device. Sprocket wheels turned by a crank engage

the film and move it through the lens in the base.



How the flashlight projects the film

### A Rain Cape of Paper Folds into Handbag

**A**N EMERGENCY rain cape that can be carried in the purse until opened for use in protecting a woman's hat and wraps from sudden showers, has been recently devised by Joseph

A. Gavin, a resident of New York City.

The cape is made of waterproof, watertight paper in black, white or tan.



The paper is odorless and sufficiently durable in texture to be used several times if handled carefully.



## Some Current Sidelights on Human Ingenuity

### Sport on Water Shoes

Tilting on "water shoes" is an exciting water sport introduced in Los Angeles, Calif. The shoes are tiny boats with long handles that press the water when the tilter pushes backward with his feet.

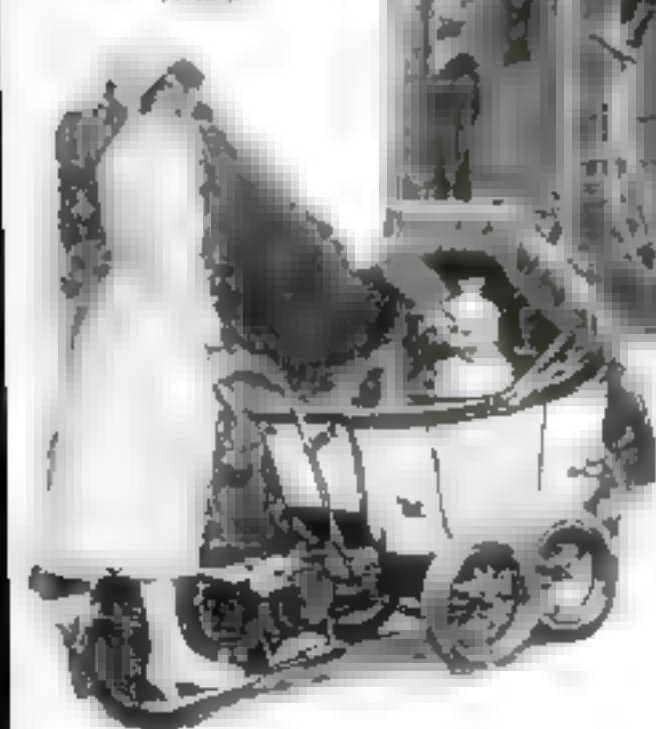


### Ask the Police

A thorough question or lay at answers for the public at a police report is given at a police booth recently established in the heart of Detroit, Mich.

### Nurse Is Chauffeur

Nurse and baby both ride in a motorized perambulator recently introduced in London, England. A traction cable, when hooked to the carriage, serves by a small gear for motor propulsion.



### A Broad Saw

Loaves of bread baked in pans are supported by a broad saw recently introduced in bakeries to prevent an exact baking of loaves.

### A Radio Violin

With a new string violin, it was stated Joseph J. McManis of Lowell, Mass. has made one by which the photo-graph Mr. McManis is showing now week tomorrow is mounted by a radio-speaker.

### How Jackies Can Climb

Interesting feats of strength and skill were performed by stalwart lads of the British Royal Naval School at a recent rope climbing exhibition at the Olympia, England. Clinging to a network of ropes, the future mariners, poised in the air, formed group figures, such as shown above.





# Machine Carves Portraits from Photograph

*New Automatic Drill Will Compete with Sculptor's Chisel as Camera Does with Artist's Brush*

**P**HOTOGRAPHS deftly reproduced in bas-relief out of ivory, alabaster or wood, a few hours after a sitting, are the outcome of an extremely ingenious method of photo-sculpture invented by Howard M. Edmunds, of England.

By this device the tedious hours of posing for a sculptured relief or a bust are eliminated. Sculptors need no longer work from living models, but from special photographs made in three minutes' time. Copies of intricate statuary, friezes, decorative pediments, and similar reliefs can be reproduced with a fidelity to surface and texture that defies the closest comparison with the original model.

Mr. Edmunds' method combines the arts of photography and sculpture. Although worked out and developed at present as a manual process, there appears to be no fundamental reason why automatic machines cannot eventually be arranged to carry out the reproduction with only the oversight of an attendant.

To produce a bas-relief of a living subject the subject is placed before a camera. A magic lantern or stereopticon beside the camera throws a beam of light on the subject's face. In the slide groove of the lantern is placed a transparent glass plate, bearing on its surface a series of finely drawn black lines arranged in spiral form like the spirals of a phonograph record. First, the lantern is focused so that the lines on the glass plate appear sharp and distinct on the face of the subject.

## "Blocking Out" the Portrait

When they are viewed through the lens of the lantern, these lines preserve their parallel structure; but at one side, in the position of the camera, the lines are no longer parallel. They seem to sag at certain points. Further examination discloses that these deviations occur whenever the contour of the subject's face recedes from the camera. The greater the recession, the greater the divergence of the lines. By focusing the camera on these lines a record is made of them and used later to carve out the facsimile of the subject.

The negative print is developed and then enlarged to the desired size of the relief. Since enlargement on bromide paper would insert a possible distortion in the fine lines due to uneven shrinkage of the paper, Mr. Edmunds enlarges his prints on sensitized opal glass. After enlargement the print is projected back to a



Spiral lines projected from a stereopticon to the subject's face are photographed by a camera offset at one side. These lines, reproduced on a sensitized plate, serve as a guide for the sculpturing machine.

parallel plane to detect any distortion due to optical errors in the lenses. These errors are carefully corrected before the plate, called the guide plate, is inserted in the machine for the carving operation.

## Plate Guides the Drill

The guide plate is placed in the carving machine with the line of displacement of the spiral lines parallel to the drill. Above the guide plate, and connected solidly with the drill, is a microscope with cross hairs in the objective. The drill is fixed mechanically so that it moves in and out along its length, but cannot move sideways. The

lever so that, as the guide plate rotates, the intersection point of the cross hairs of the microscope follows the same spiral line from end to end. Since the lines on the guide plate are distorted from the true spiral, the movement of the bar causes the drill point to move as well, and so to cut a deeper or shallower groove, according to the amount of distortion. Thus one groove after another is cut in the material.

The fineness of the finished work depends on the closeness of the lines that guide the drill. If only a few lines are used, the finished relief will show the spiral paths of the drill. In practice, Mr. Edmunds has found that 20, 40, and 100 lines an inch can be used with satisfactory results. When 100 lines are used, the grooves in the finished carving are so fine as to be scarcely noticeable. They are no more evident than the minute dots that compose the half tone illustrations in this page.

## Relief Can Be Varied

By changing the position of the camera that records the spiral lines the degree of relief can be varied. If the camera is placed near the stereopticon, sculptured relief will be shallow, but by increasing the distance between the two instruments, the depth can be greatly increased.

The amount of labor required to complete a photograph in relief depends upon the size and the fineness of the surface desired. The work cannot be hurried. A guide plate containing 200 spiral lines can be completed in eight hours. One false move after hours of work will completely ruin the carving, but after short practice an operator becomes sufficiently proficient to eliminate the probability of disaster.

While the inventor has not attempted to prophesy the future of the invention, scientific bodies recog-



This guide plate shows the face covered by the spiral lines. The straight horizontal line assists in adjusting the machine.



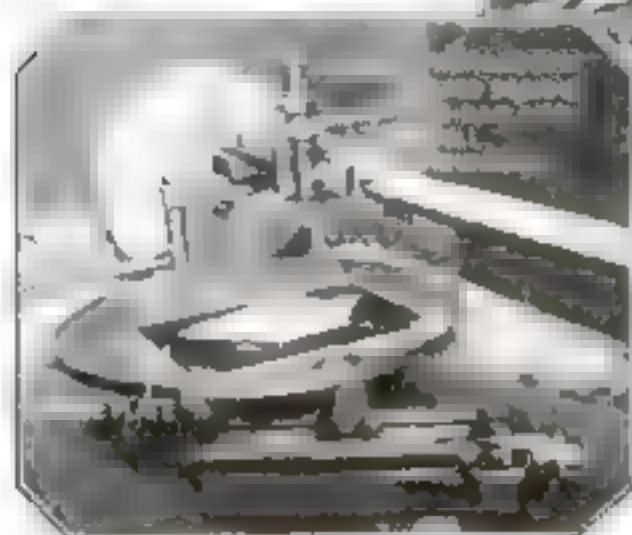
nize in it a method that will make possible the reproduction of the works of the old masters on any scale and to any degree of relief. Friezes and sections of pediments located in difficult positions for extended study by a sculptor could be photographed and reproduced in perfect detail. By reversing the action of the machine it is thought that concave engravings in the form



Above is Howard M. Edmunds, the inventor, at work on his machine. The drill at the right is carving a bas-relief from a block of alabaster.

The guide plate of opal glass containing the spiral lines is attached to a motor driven table as shown at left.

A rapidly turning drill, shown at right, moves against the piece of work as the microscope follows the guide plate lines.



## Wind Operates Traffic Signal Light

BY COMBINING the anemometer, or wind gage, with a silent policeman, the city of Detroit has produced a wind operated safety signal for traffic that cannot fail to attract attention.

At the top of the pedestal, which is heavily weighted at the base, is a red globe



Small cup shaped vane, rotated by the wind, operate this silent traffic policeman.

containing a powerful electric bulb burning continually. The shaft of the wind gage, mounted above the globe, passes into the globe, where it is attached to revolving opaque blades.

As the prevailing wind drives the cup shaped gage, the vane rotate around the light bulb, producing flashes of varying duration, depending entirely upon the strength of the wind.



## Road Roller Rides to Work on a Trailer

TO FACILITATE moving heavy road rollers from one job to another, the Board of Public Works of the city of Detroit has devised a trailer equipped with a special reinforced tailboard, up which the roller can be run under its own power. This trailer with its 10-ton load can be moved at eight miles an hour, while the roller makes but three on its own wheels.

## Light Rapid Fire Gun Has Only 38 Parts

A NON-RECOIL, submachine gun that can fire 1000 rounds of ball, shot, or slug cartridges in one minute and nine seconds, has been invented by John T. Thompson, a retired general of the United States Army.

The weapon consists of 38 parts, in contrast with the usual 200, and weighs 10 pounds. It can be fired in single shots or in "bursts" like the ordinary machine gun.



Firing the non-recoil gun with its butt held against the nose.

## Mounds of Earth Serve as Pipes for Coolies

ALTHOUGH coolies in India and South Africa cannot take their favorite water pipes with them when on the march, they find a satisfactory substitute in earth pipes constructed along the way.

In South Africa the pipe is built up on the ground surface by heaping a little mound of earth and making a small tunnel through it. The tobacco is placed at one end of the opening while the native, kneeling at the other, sucks in the smoke.

In Natal and Rajputana the pipe is a sunbaked tube of clay hollowed out in the shape of a cone.



How coolies make and use their strange earth pipes.



# One Man Builds Domed Church

**C**OMBINING in its wide sweeping dome, its windows, and cornice decorations, interesting features of Moorish, Greek and Norman architecture a unique religious edifice under the name of Bethany Temple has been constructed in the city of Sierra Madre, Calif., by one man. Nothing about the edifice is professional. All the materials were taken from near-by sources.

The temple proper is 52 feet in diameter and 30 feet high from ground to top of dome. A second building, which houses the Sunday school, is 57 feet in diameter and 18 feet high. Both structures are built of cement blocks with a facing of smooth granite stones lifted from a near-by mountain stream.

Extensive as the buildings are, the entire construction work was done by a local artisan L. D. Cornuelle, under supervision of the Rev. W. H. Rawlings. It required a year and a half to complete the structures.

In building the temple and school, Mr. Cornuelle adopted an unusual method of scaffolding. After the course had been carried to a point as high as he could reach from the ground, a spring wagon was drawn alongside and used as the staging. When the new height had been overreached, a platform was erected and up this the wagon was drawn. As the tier spread to one side

The sweeping arches of the church and the semicircular windows under the eaves are shown in the interior view at the right. Note the excellent finish of the auditorium.



Gothic windows and graceful domes with walls of stones taken from near-by streams were selected by the designer to distinguish Bethany Temple, a religious center at Sierra Madre, Calif.

At the right is L. D. Cornuelle, who constructed the buildings. His ingenuity enabled him to erect the walls and domes alone and without the customary extensive staging.



or the other, the wagon was shifted along the platform. Later a staging was built upon the wagon and this gave the necessary height for the completion of the walls.

Only the dome is of wood; all else is concrete. Departing from the usual method of dome construction wherein the rafters supporting the dome are sawed to shape, Mr. Cornuelle bent one-by-three timbers to the

required curvature and then nailed several of them together to give rigidity. Over the rafters he placed lead covered asbestos paper well sanded with broken gravel to match the concrete and stone of the walls.

The edifice is illuminated by indirect lighting in invisible fixtures in white and soft colors that can be manipulated at will.

## Oil Rams Tip Truck Body to Right, Left, or Rearward

**B**Y MEANS of oil operated rams controlled by an oil pump driven direct from the truck engine shaft by friction disks, a remarkable new cart body can be tipped for dumping from sides or rear. The entire apparatus weighs only 200 pounds.

The two rams, placed inside the chassis frame just forward of the rear wheels, consist of slender cylinders in which the pistons are moved by the pressure of oil fed into the casing from an oil pump. A rearward handling

the truck frame under the driver's seat. The force pump is built into the reservoir.

In the driver's compartment a friction wheel handle controls the motion of the oil pump and a hand operated valve permits the oil to return to the container when the tipped body is lowered.

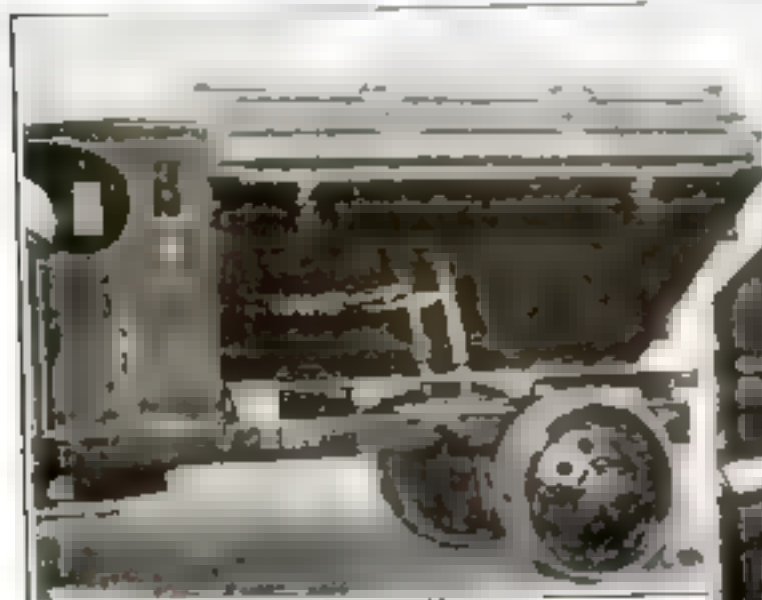
Although one of the rams travels a greater distance than the other in tipping the body to one side, automatic valves provide for the same pressure in each ram.

When the body is lowered, the rams return to their original position.

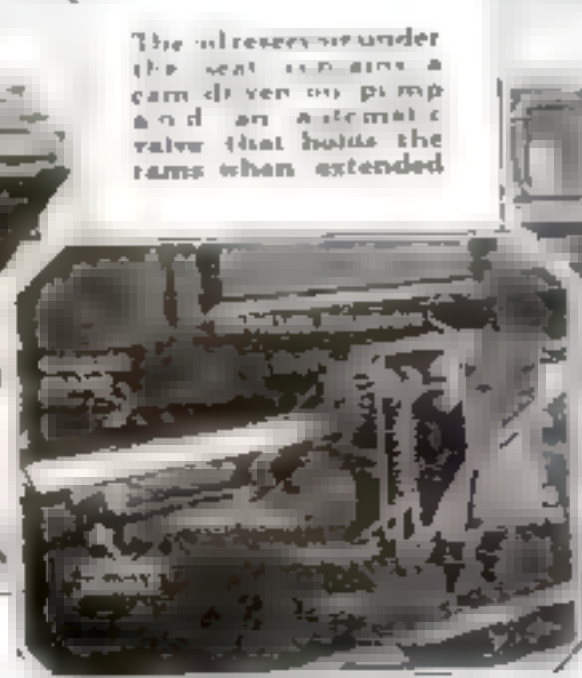
sufficient clearance to avoid damage from roadway obstructions.

The direction of tip is controlled by the driver, who pins or locks certain hinges. Since the body normally floats without rigid fastening at either side, the dumping side must be pinned before the rams are started.

The dumping mechanism has been found to work efficiently on lubricating oil removed from the truck engine.



For side-dumping, the truck driver pins one side, unhinges the other, and throws the control handle.



The oil reservoir under the seat contains a cam driven oil pump and an automatic valve that holds the rams when extended.



Dumping to the rear. The rams have sufficient clearance to pass over any obstacles cleared by the rear axle.



# How Eddie Hubbard Makes Flying Pay

**H**ERE is the story of an enterprising American aviator who runs probably the only one-man air line to the United States and makes a good living from it. His success is interesting confirmation of what Glenn H. Curtiss said in the July, 1922, **POPULAR SCIENCE MONTHLY** concerning a young man's chances of making money in commercial flying.

You will enjoy reading how Eddie Hubbard, as the pilot of his own United States mail route, has been clearing over \$80 a trip, while maintaining the traditions of the service for punctuality.

**S**AID to be the only commercial aviator in the country who is making a financial success of a regular flying route, Eddie Hubbard, of Seattle, carries United States mails in his seaplane on an ironclad schedule 10 times a month between Seattle, Wash., and Victoria, B. C., a distance of 84 miles.

Assistant Postmaster Otto Fraeger, in 1920, foresaw a saving in time if mail for the Orient could be handled by plane between Seattle and Victoria. Bids were called for. Hubbard won, and has had a continuous contract ever since.

Flying through thunderstorms, bucking the gales of winter and the storms of early spring, Hubbard's plane gives eight hours' faster service than the fastest boats. And sometimes the boats are held in quarantine. This can never happen to the plane. Ten

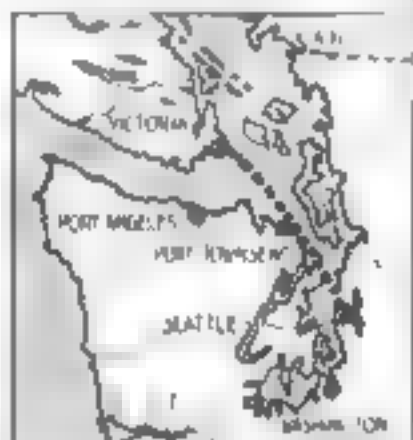
times a month, 120 times a year, Hubbard and his plane deliver letters in Victoria three hours after loading the plane in Seattle. The government demands 100 per cent efficiency and Hubbard has never failed.

Only first class mail is carried. Hubbard's plane carries about 600 pounds of mail, averaging 24,000 letters.

For each round trip Hubbard receives \$200. He uses 36 gallons of special gasoline costing \$10.60 and one gallon of oil at

\$1.10 a gallon. But his greatest expense is the depreciation of his plane. Its life is only 500 hours of actual flying, which means that he must charge off one five hundredth of the purchase price of \$18,000 each hour he flies. A second big item is the insurance on the plane. Insurance companies charge a premium of 25 per cent of the insurable value, which is \$10,000. So \$2500 must be paid each six months, since his plane is never insured for longer periods. Adding these charges together, it is seen

Eddie Hubbard, above on the right, helps to put aboard some of the 24,000 letters that he carries regularly on his air mail plane. The map at the left shows the route covered by the Seattle-Victoria mail line and explains why the seaplane gives water-locked Victoria its most satisfactory means of communication with Seattle.



As proprietor of what is said to be the only one-man express service in the country, Eddie Hubbard of Seattle, second from right above, recently took on the dramatic job of rushing bloodhounds and detectives to the scene of a bank robbery, thus aiding the escape of the criminals.

hat out of the \$200 paid by the government for each round trip, Hubbard must deduct \$112.36 as "overhead," leaving him a clear profit—barring serious mishaps—of about \$88 for each trip.

Since Hubbard's mail delivery takes only 10 days a month, he uses the remaining time to make money with his other "ship" which he rents out for one dollar a minute.

He is sometimes called upon to help in running down criminals. A few months ago he carried two deputy sheriffs, a reporter, and two bloodhounds in his plane to Sequim, Wash., where two bandits had held up and robbed a bank. A few hours after the dogs had been liberated, the robbers were in custody. If the dogs had been sent by train, the pursuit would have been delayed 12 hours, giving the thieves time to make their escape.

There is nothing of the daredevil in the appearance of Eddie Hubbard. He is known to be absolutely fearless—his term as a flying instructor at Rockwell Field during the war proves it; he never indulges in spectacular stunts.

## Cement Filled Shell Boxes Form Bricks for Rebuilt Homes



**B**OXES in which shells were transported to the front during the war are now being used in the battlefield districts to rebuild homes. The boxes are first filled with cement and allowed to dry.



They are then assembled like hollow tiles, forming walls of great strength. Above at the left, workmen are tamping the cement in place. At the right is shown a pile of the discarded boxes.



## Sensitive Air Tubes Detect Fire and Ring the Alarm

**E**MPLYING a principle new to automatic fire detection apparatus, a pneumatic electrical system has recently been devised that will invariably turn in an alarm within 30 seconds after the fire starts.

The new system is based upon the expansion of air in a closed tube rather than on fusible elements, and is so designed as to distinguish automatically between the heat of a fire and a gradual rise in temperature due to near-by steam pipes or heating systems in the industrial plant.

The detector consists of one or more circuits of small copper tubing containing air at atmospheric pressure. The tubes extend across the ceiling or on the side walls of the area to be protected, and are spaced about 18 feet apart. Each end of the tube circuit opens into a diaphragm made from a flexible sheet of German silver 0.002 inch thick. These diaphragms are placed opposite each other, and very close together. When heat from a fire expands the air in the tubes, the pressure is transmitted through the tubing to the diaphragms, causing them to expand toward each other. When the sum of the pressures exceeds a certain set amount, the two diaphragms touch and



When tested with a pan of burning alcohol, the fire alarm shown in detail at the right, rang the alarm 26 seconds after the fire started on the floor below

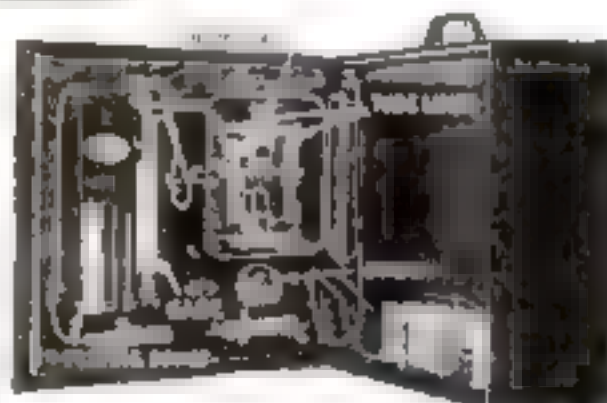
close an electric circuit, which rings the fire alarm.

If this were the entire system, however, it would turn in an alarm when the steam heat was turned on, and on every hot day in summer. To make the apparatus unresponsive to weather changes, a fixed vent is inserted in the tubes near each diaphragm. If the temperature—and therefore the pressure in the tubes—rises at less than a certain predetermined rate, these vents

relieve the pressure as fast as it is produced. But in case of fire, pressure is built up faster than the vents can dispose of it, and the alarm rings.

Compensating chambers are also interposed between the tube line and the diaphragm to intercept temporary heat effects caused by steam pipes or the work going on in the building where the system is installed. The chambers provide additional volume in the tube system.

The sensitiveness of this system has been demonstrated recently by two official tests made under most adverse conditions.



Diaphragms placed between two air tubes touch each other when the heated air expands, completing an electric circuit and ringing the alarm



### Five Room Tent-Bungalow Fits on Runningboard

**T**ENTS built on the unit plan are now available to the automobile camper and tourist. By adding rooms around the outside of a center unit, a five room shelter is possible.

The central unit folds when not in use and opens like an umbrella, with pole and ribs of seamless brass and aluminum tubing. The outside diameter of the tent when folded is only 12 inches, so that it can be packed on the runningboard of the tourist's automobile.

## Stage Martyrs Keep Cool in Mock Fire

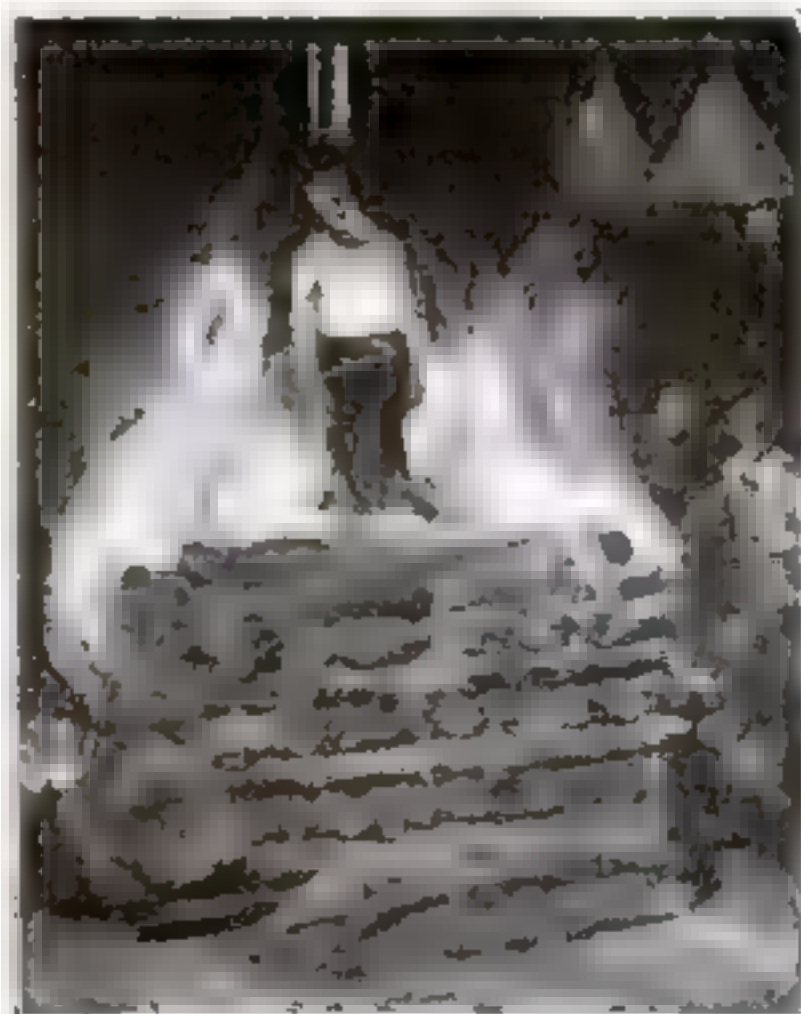
**T**O BE burned at the stake is not so uncomfortable—on the stage. Though the fire seems to be eating into the heart of the logs, and the burning embers shoot tongues of flame about the martyr's feet, he is cool, for the fuel of this fire is fireproof.

The logs are made of asbestos built up with wire netting, painted to resemble wood and sprinkled with wood ashes. The glowing embers are only electric lights behind red paper, and the darting flames are long streamers of brilliant

red silk that flutter in the air current that arises from a 10-inch electric fan placed at the foot of the pile. A separate battery of red lights that throw a strong glare on the silk streamers gives the remarkable illusion of flame.



Streamers of bright red silk, illuminated by batteries of red electric lights and fluttering in the breeze from an electric fan, are the basis of the darts of "flame" in this stage pyre





# India's Mysterious Star Pointers

## Astronomy for All

THE public's first real chance to observe the wonders of the heavens through the powerful modern apparatus of astronomers has come through the efforts of Professor Frank Schlesinger, new director of the Yale University Observatory, New Haven, Conn. On two nights of each week one of the observatory domes, with its telescope, especially equipped for the purpose, has been opened to laymen. Admission is by ticket obtained by written request to the observatory, stating the preferred date.

The queer pictures of 17th century astronomical devices shown on this page, are in striking contrast to the huge yet delicate instruments of modern observatories. But these Oriental "star pointers" had in common with modern telescopes the one fact they were the monopoly of the privileged few. The step taken at Yale toward revealing the magnificent secrets of the heavens to the public might well be followed by other universities.

The stone instruments in the strange astronomical observatory at Jaipur, India, shown below are star pointers, marking spots in the sky where sun or planets reach their highest altitudes on definite days of the year. From these dates the Hindu calendar was corrected.



For observing the sun, the above instrument, called "Mura Yantra," was one of the important devices. By placing a pointed stone marker on the central steps and standing on one of the outer flights of steps with the chin on the circular wall, the Hindu astronomer obtained eight lines for plotting movements of heavenly bodies.

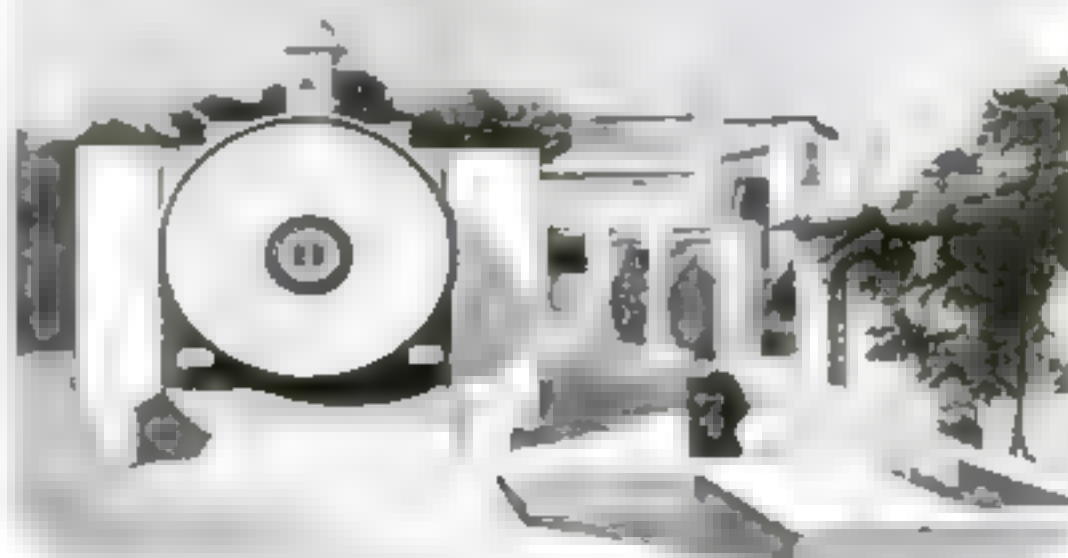


COMPARED with modern high powered reflecting telescopes that photograph celestial bodies thousands of light years away, the strange stone astronomical instruments pictured on this page appear grotesque. Yet with these queer, blocklike instruments, some of them resembling sun dials, Hindu astronomers gained surprisingly accurate knowledge of the heavens long before the invention of the telescope. Indeed, they were able to calculate an eclipse to the fraction of a minute, and could fix the exact length of the solar year—a complicated astronomical calculation—within a few minutes of the correct measurement.

The greatest Hindu observatory, near Delhi, India, is built of polished marble. The stone "telescopes" were erected in the seventeenth century, and marked the high tide of native Hindu astronomy. The builder was a famous fighting king, the Maharajah Swai Jai Singh of Jaipur. From his early youth this prince was interested in the stars, and when he found the Hindu astronomical tables and calendar in error, he set out to correct them, sending scientists throughout the East to collect and translate books on the subject.

In correcting the calendar, the maharajah tackled a difficult problem. Since the Hindu year was based partly on the position of the moon, and partly on the position of the sun, and since the lunar year contains 354 days, while the solar year contains 365 1/4 days, the resulting confusion may be imagined. We still have one survival of the lunar calendar—the date of Easter varies each year because it is reckoned by the moon.

The maharajah solved the complicated problem of reconciling time by the sun, time by the moon, and time by the stars—all different—by erecting his strange stone structures, which in reality are not sun dials, but star pointers. These dials point to spots in the heavens that the sun and



The vertical, circular stone shown above points north and south. It was used to determine altitudes of stars in the meridian.

certain important planets occupy at certain definite times of the year. One dial points at the sun at the moment of high noon on the vernal equinox. Before

the sun again occupies that position at the moment of noon, exactly a year will have elapsed.

Other pointers mark similar important points for the moon and the planets. Comparing the various readings by observing the positions of shadows cast by the slanting gnomons of the dials, the Hindu astronomer obtained a very close idea of the relations of solar, sidereal, and lunar phenomena.

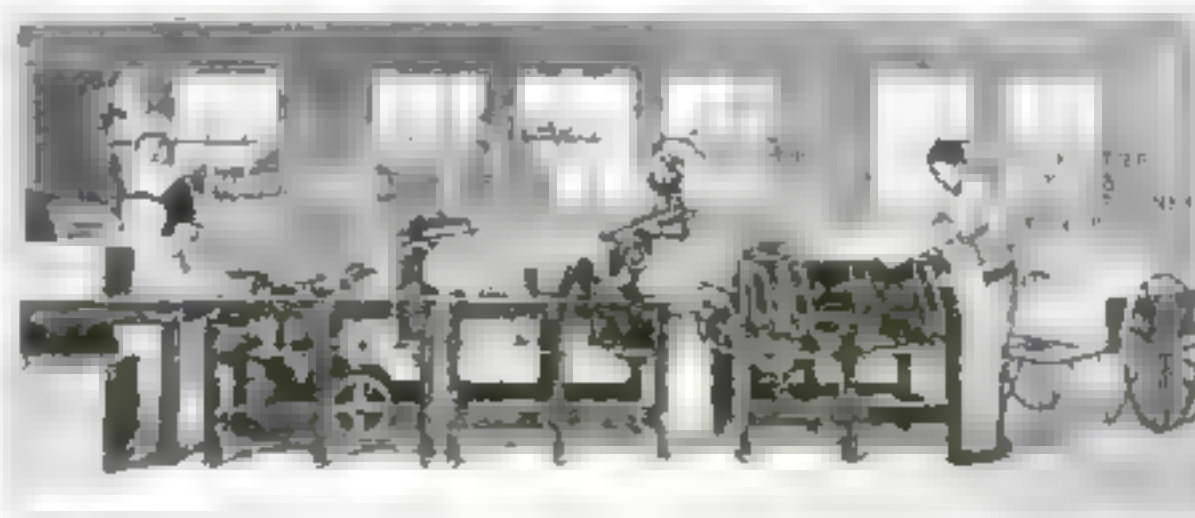
The observatory also contains an armillary circle and an astrolabe for taking altitudes of the sun and stars at odd times. The dial marked the fixed points and eight lines to which all motions of the stars were referred, making it comparatively simple to chart the apparent motions of heavenly bodies.

## Machine Wraps 1500 Pounds of Butter an Hour

WITH a new automatic molding and cartoning machine, two girls and a man can cut, wrap, and deliver ready for packing 1500 pounds of butter or oleo an hour. The machine comprises a molding device with refrigerating attachment, a

parchment-folding machine and a cartoning device that places the complete mold in its shipping case.

The butter is dropped into a hopper and passes downward into molds. The refrigerator freezes the butter for packing.



Bulk butter is compressed into pound prints, wrapped, cartoned and packed into boxes automatically by the machine methods shown above.



# Tree Planters in Losing Race with Forest Fires

IN AN attempt to compensate for the loss of the immense acreage burned annually by forest fires, the United States forest service is sending thousands of men into the parks planting thousands of seedlings where the conditions are right for their growth.

According to the forest service, the forest officers have had to plant more than 100,000 seedlings in the remaining timber of the country. In these plantations, however, the forest fires are still a menace, and could have been prevented by using ordinary care.

## Criminal Carelessness

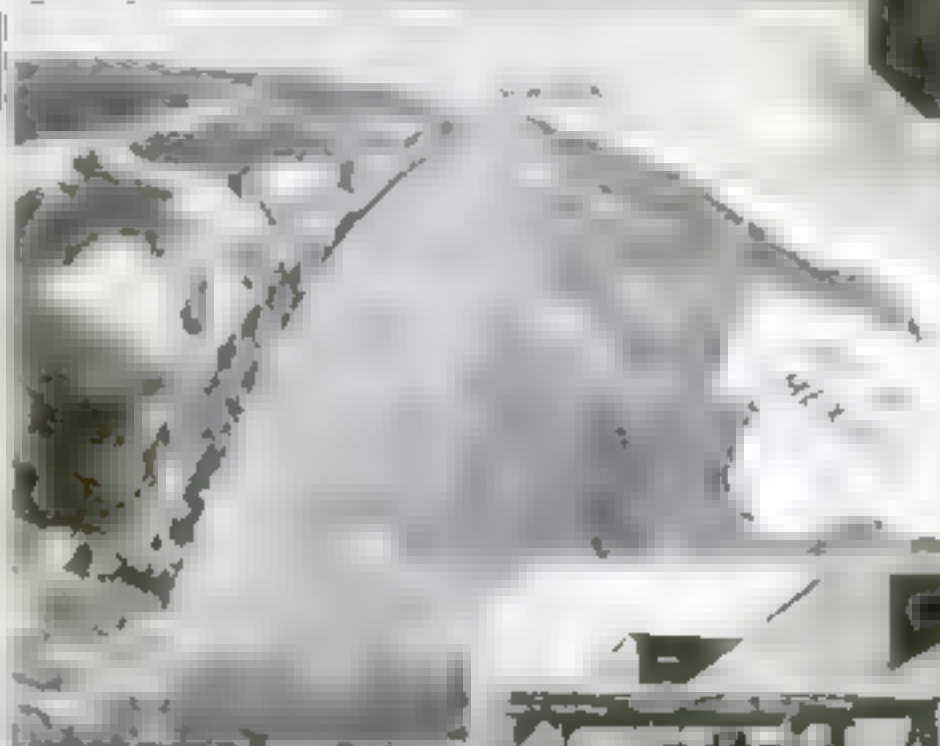
As a matter of fact, 90 per cent of all the forest fires started by man in the national forests of the West during the past year were caused by carelessness. In Arizona, New Mexico, and other parts of the West, the forest service has been fighting a losing battle by burning the forest fires, and by planting seedlings in the burned areas.

A recent fire in the Forest Service has burned over 100,000 acres of forest land. The National Forest of El Yunque, in New York, was burned over, and the area destroyed was 10,000 acres of land 10 miles long and 10 miles wide. The fire was caused by a man who was cutting wood in the forest.

The forest service is now sending thousands of men into the parks planting thousands of seedlings where the conditions are right for their growth.



This tree planting tool consists of two pieces of boiler plate with sharp-pointed handle attached to a handle.



## Our Appalling Fire Loss

Forest fires in the United States during the past year have caused a loss of \$100,000,000. The loss is appalling, and the forest service is now sending thousands of men into the parks planting thousands of seedlings where the conditions are right for their growth.



Fire trucks used in protecting Olympic Forest. Wash. carry water with pump and pump.

## Trees' Slow Growth

The forest service is now sending thousands of men into the parks planting thousands of seedlings where the conditions are right for their growth.

## Pronged Club Reveals Faults of Golfer

For the first time, the face of the club, instead of being a smooth surface, is now covered with needles or prongs. When the



Sharp prongs hold the ball to the club.

face strikes the ball, the prongs are embedded in the ball, and the ball is held fast to the club. After the swing has been completed, a study of the position of the ball on the club face indicates to the golfer the nature of his errors.

## Phonograph Records Made at Home

The first time a person has been able to make a phonograph record at home is now possible. The new machine is simple to use, and the records are of good quality.



The singer's voice is reproduced on the wax record by a cutting stylus moved by friction disks.

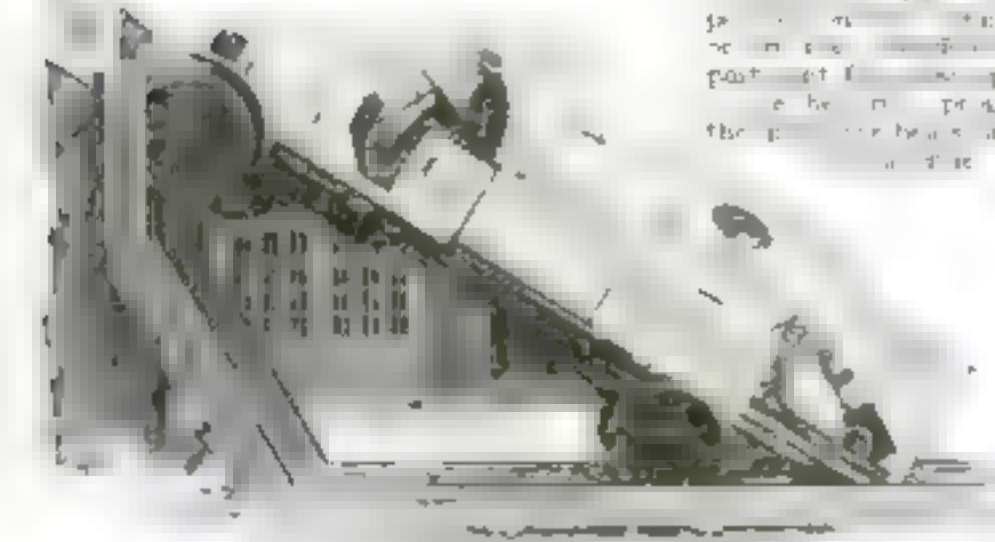


# Camera Keeps Pace with Invention



**Color in the House**  
By changing the color of the lighting with the parchment shade the color of the house can be altered to please the owner. The color of the house can be altered to please the owner. The color of the house can be altered to please the owner.

**Truck Climbs a Wall**  
The latest in the line of motor vehicles is a truck that can climb a wall. The truck is a motor vehicle that can climb a wall. The truck is a motor vehicle that can climb a wall.



**This Pitcher Never Tires**  
Ty Cobb shows how the latest battering machine operates. A pitcher of the new type is shown in action. The pitcher is a motor vehicle that can climb a wall. The pitcher is a motor vehicle that can climb a wall.



**A Limousine Film**  
Carmen and director, the new film, is a picture of a limousine. The limousine is a motor vehicle that can climb a wall. The limousine is a motor vehicle that can climb a wall.



**Plaster Pies for Movies**  
Pie and pastry—the kinds that are thrown but not eaten—are comedies are produced by sculptors who use plaster of Paris instead of food. So far no satisfactory substitute has been discovered for the soft, provoking custard pie.

**Is This a Pipe Dream?**  
According to Hamilton Bell, a South American traveler, the natives in that country are converted by drinking a native who wakes from his trance and travels to city to the inspired article. So fast does he travel that other natives keep up with him by tying ropes about his body.



## Tourist Cranks Himself across Stream



How the ferry raft is hauled along a cable guide by any one of three hand winches, located on the boat and on each shore



**EVERY** man is his own ferryman at a crossing on the upper Iowa River, near Decorah, Ia., where an ingenious raftlike ferry boat has been installed.

The "boat" consists of a platform constructed of timber and heavy planks, supported by four hollow steel cylinders, 30 inches in diameter and 30 feet long.

It is guided by a three-fourth-inch steel cable stretched across the river between stout posts and passing through slots in two vertical posts braced to the timbers of the platform on the upstream side of the ferry.

Whoever wishes to cross the river must turn the crank of one of three hand

winches, located on the ferry and on each shore. The steel pulling cable is fastened to one of the vertical posts of the ferry platform, passes over a winch drum attached to the guide cable stake on shore, then goes back to the ferry, where it passes over a winch drum, thence to the other side of the stream, around a winch fastened to the other guide cable stake, and once more back to the ferry, where it is fastened to the other vertical post of the platform. The pulling cable may be operated from either shore or from the ferry, by turning the crank of any one of the three winches.

## Crutches on Wheels Give Patients Exercise

**TO AID** crippled patients to regain the use of their limbs, a crutch in the form of a light framework resting on wheels, which may be adjusted to fit the height of the patient, has very recently been invented.



Walking with the rolling crutch

Two upholstered bars, raised to fit under the patient's armpits, support his body and enable him to exercise his legs without the risk of falling. By systematic exercise the power of the muscles is restored.

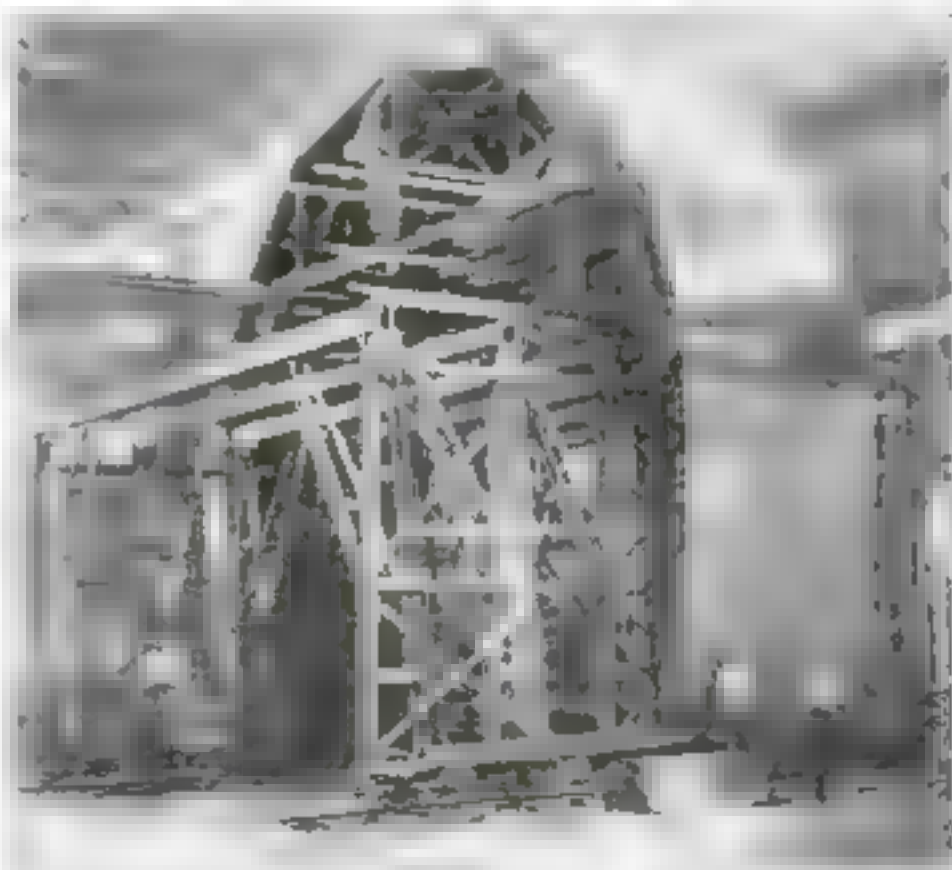
## Traveling Steel Forms Build Tunnel

**HUGE** traveling steel forms, 32 feet or more in height and diameter, have been perfected recently to speed concrete construction work in tunnels and hydraulic projects. The frame is mounted on rollers, and moves forward on a steel traveler as the work proceeds. This steady program keeps the concreting gang up to a predetermined schedule, as the rate of advance can be varied to suit local conditions.

The form is never dismantled during the progress of the job, as is the case with wooden concrete forms, and no changes are required after it has once been erected. The exterior surface is made smooth, with no joints which the concrete can penetrate, and, by hardening there, make further movement of the form impossible.

It is claimed that

tunnels built with these new forms have a smoother interior finish and adhere more closely to engineers' specifications than those constructed by other methods of building now practiced.

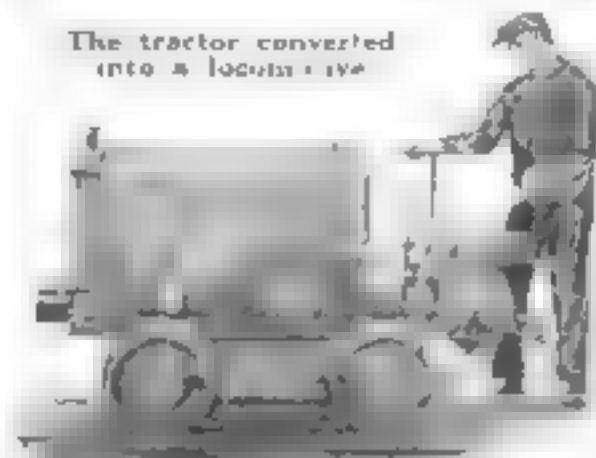


As the concrete work proceeds, the frame of the form rolls forward on a steel traveler

## Endless Tread Tractor Becomes Locomotive

**A SUCCESSFUL** type of industrial locomotive has been developed from the "endless tread" tractor by a manufacturing concern in the Middle West. Several

The tractor converted into a locomotive



years ago this concern placed on the market a tractor intended for agricultural and industrial uses. It proved highly satisfactory under severe tests, hauling strings of heavily loaded trailers over rough and difficult roads. But, being of the endless tread type, it lacked speed when used in hauling loaded cars on a narrow gage track, at mines, quarries, oilfields or plantations.

To obtain the desired speed, the tread chain was removed, flanged wheels were substituted for the sprocket wheels and other minor changes were made by which the original tractor was adapted to its use as a traction locomotive.

## Gold Has Many Colors

**THE** color of gold by daylight appears to be a brilliant yellow, yet when the metal is beaten thin and held up to a light, the color is green. In powder form gold is ruby red, when heated, the color is purple.



# Can Levees Ever Conquer the Mississippi?

*Grim Battle against Stealthy River, Waged by United States Engineers, Might Be Helped by Construction of Spillways*

**F**IGHTING a grim battle against the stealthy, undermining attack of surging waters, engineers under the supervision of the War Department continue to construct levees along the lower Mississippi in an attempt to hold the "Great Western Sewer" within its bounds.

stand the scope of the natural and constructional difficulties involved. The Mississippi River drains two thirds of the area of the United States and sluices 2,250,000 cubic feet of water a second through a natural funnel shaped bed from one to 10 miles in width. Water with a velocity of 11

and "sand boils," which are a constant menace to the completed work.

The slides usually occur on the land side of the levee and are due to thin water-soaked layers of earth. Their movement is rapid. In one instance a guard observed indications of a slide two feet back from the

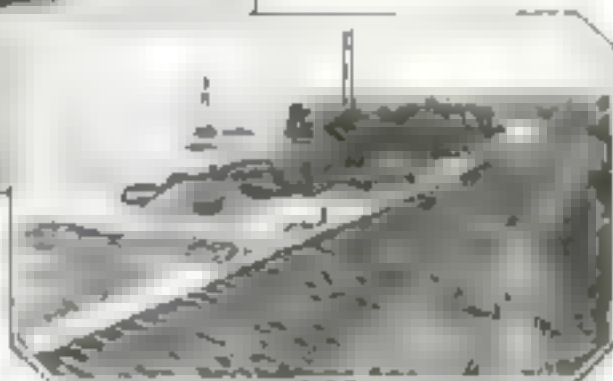
## The Danger "Boil"

In the photograph below may be seen a small, bubbling "sand boil" forming at the base of a levee, as the river stealthily tunneled the bank. Later it was necessary to mattress the whole area.



## Guarding Rails

Extra heavy bulk heads with a topping of sand bags, braced with cross-braced timbers, protected railroad tracks near Arkansas City, Ark. during a recent flood as shown below.



When a boil is discovered a small levee of sandbags is built across it. When the "boiling" water reaches the level of the river, pressure on the levee is removed.

feet a second and a depth of 105 feet is frequently encountered. But the volume represented by these figures is the present one. As the timber on the watersheds is removed, the moisture will be more quickly released and the river torrent increased.

## Where Danger Lies

Today the crux of the situation is said to be the 200 miles above Vicksburg, created by the closing of a two-mile gap in the levee above Arkansas City, which formerly provided an outlet for 200,000 cubic feet of water a second.

The dramatic struggle between man and the mighty river is never ending. Sometimes the water gains its advantage slowly, at other times it breaks free suddenly where no break is expected. In time of rising water guards patrol the levees day and night, keeping a sharp lookout for slides

levee top, and while the report was being transmitted to headquarters the rift lengthened to 180 feet. It required half a million bags of sand piled around the slide to hold back the threatened overflow.

Boils are caused by water tunneling through gravel underlying the levee. Through these tunnels the water at great pressure from the high level of the river filters under the levee and reappears on the land side as extensive patches of bubbling waters. If the boils are allowed to continue unchecked, the levee sags and within a short time the water from the river surges through the weak spot thus developed. Boils are most dangerous when they appear close to the "top" or base of the earth bank. When they crop up a thousand or more feet away, the chance of disaster is considerably lessened.

Whenever muddy water is discovered boiling up at the base of the levee, a small levee of sand bags is thrown around the boil. The water is allowed to rise to the height of the river and all pressure is removed.

## How Levees Are Built

As long as the water seeping continually through the levee remains fairly clear, there is no immediate danger.

Usually Mississippi levees are built to a height of three feet above the highest flood stage. After completion they are sodded with grass as a protection against erosion by rain. For additional strength a layer of concrete is sometimes added. During a recent flood, railroad tracks near Arkansas City, Ark., were protected by extra heavy bulkheads with a topping of sand bags braced by timbers.

Meanwhile, many farmers living their alternating dry and flooded existences under the precarious banks of earth and willow insist that the levee can never be a complete solution of the problem. Levees that are high enough now will be overrun, they say, when new high water marks are reached, thus ending for continual additions to the height of the banks and increasing the extent of disaster when a break-through actually occurs.

## Spillways to Supplement Levees

Because of the great difficulty in maintaining levees intact and the impossibility of predicting the limits of future high water marks, opponents of the levee system are now suggesting that it be supplemented by spillways from the Mississippi, one leading into Lake Ponchartrain to the east, which in turn empties into the Gulf of Mexico near New Orleans; another to the Atchafalaya River on the west, also emptying into the gulf. The Atchafalaya is declared to be a natural relief valve for the Mississippi.

The construction of either spillway would involve purchase of land for spillway outlets. Dikes built along the outskirts of these strips would form sluiceways into which flood waters could be dumped and sluiced through to the gulf without damage to landholders and tenants along the way.

The magnitude of the government levee work already completed along the river is astounding. During the 50 years since the work was commenced, over a billion dollars has been expended with the end not yet in sight.

Few persons outside the engineering force in charge of the project under-



Broken lines in the above map indicate proposed spillways from the Mississippi to the Gulf of Mexico by way of Lake Pontchartrain on the east and the Atchafalaya on the west.



# Automatic "T" Signals Wind Direction to Fliers

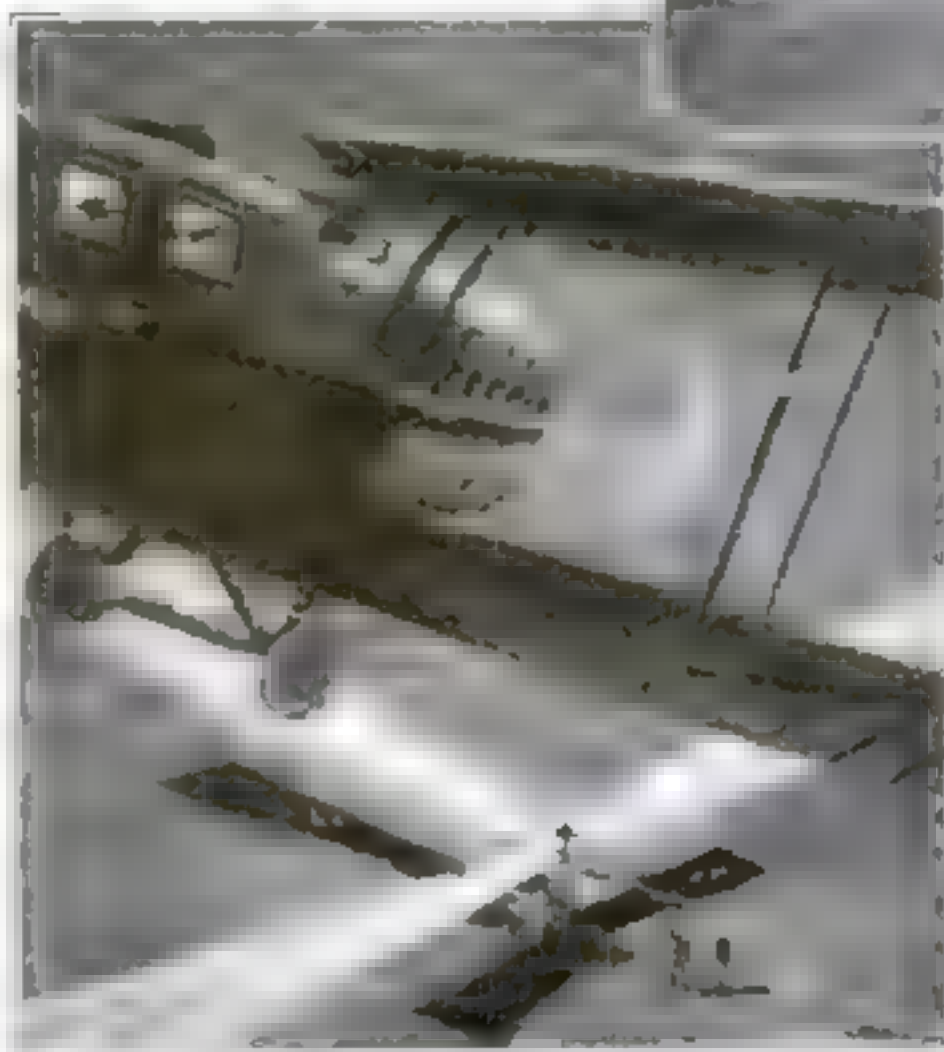
## New Ground Sign Flashes at Night

NIGHT flying planes will be aided in making landings by an automatic illuminated wind indicator and ground sign resembling a weather vane now undergoing tests at the Croydon aerodrome near London, England. The same indicator is useful for signaling aviators by day.

At present the ground sign and wind indicator in common use on landing fields consists of long wooden platforms, painted white and joined in the shape of a T, the long arm of the T indicating the direction of the wind. The use of this sign necessitates employment of a crew of men to shift the position of the T whenever the wind changes.

The new automatic device, also in the shape of a T, consists of a framework with two winged white arms, pivoted like a weather vane and with a powerful light source placed at the intersection of the arms. The long arm is 20 feet long, and the short arm 10 feet.

In operation, air currents,



Arms of the "T," mounted like a weather vane, as shown above, are illuminated for use as a night signal by a powerful light at the intersection of the arms. The long tail indicates wind direction.

exerting a pressure on the long tail, swing the head of the T into the wind. A series of lenses on the four sides of the lamp house throw beams of light along the white painted arms. The light source is fed from cylinders of dissolved acetylene gas stored under the framework, and produces an illumination of 27,000 candlepower.

As a day sign, the indicator can be seen five miles away by a plane traveling at normal flying height. At night the light can be distinguished 12 miles away. Its shape can be distinguished for two or three miles.

## 110-Foot Pipes Laid in Single Lengths

BULKY 110-foot lengths of six-foot corrugated iron pipe, with tide gates attached, handled by special machinery and laid in exact position with the aid of piling, have been the means of draining and reclaiming 5600 acres of Columbia River overflow land in Cowlitz County, Wash.

The weight of each culvert section alone was six tons and the self acting gate on the end weighed another ton. Tests showed that the heavy pipe could be suspended safely from three points and hoisted. But a mishap with the first section proved that in lowering the huge pipe, the friction

drums of the clamshell dredge would slip. Therefore resort was had to the manipulation of the steam cocks on the cylinders of the hoist engine, using compression of the engine to control the descent. Rows of piling were constructed to hold the culverts in place while filling in with soil.

At the lower, discharging ends of the pipes tide gates were installed to permit the exit of the drainage water, but preventing the ingress of tide water during times when the pipes were submerged.



## Draftsman Can Palm This Handy Ink Eraser

A SMALL clip around the middle finger and a short spiral spring enable the stenographer, draftsman or artist to palm the ink eraser while using the hand for other operations. The eraser is connected with the splitting finger clip by a spring.

The eraser is renewable. The holder, of spring steel, can be pried apart far enough to remove the stub and insert a new eraser.

PEARL fishers in the Gulf of California estimate that one oyster shell in every thousand contains a pearl. The average pearl-fishing party, working in water about 40 feet deep, obtains about three tons of shells a day.



Suspended at three points, 110-foot pipe sections were lifted and lowered. Inset shows drainage culverts in place, with tide gates to prevent back flow.



## Revolving Disks Sort Weeds from Wheat in New Machine

**W**EED seeds that comprise from two to 18 per cent of the total bulk of wheat as it is harvested, are now successfully removed by a machine developed by the United States Department of Agriculture. These foreign seeds, made up as they are of wild oats, wild buckwheat, vetch, and king-head, must be removed from the yield before the wheat is ground into flour.

### Pockets Catch Weed Seeds

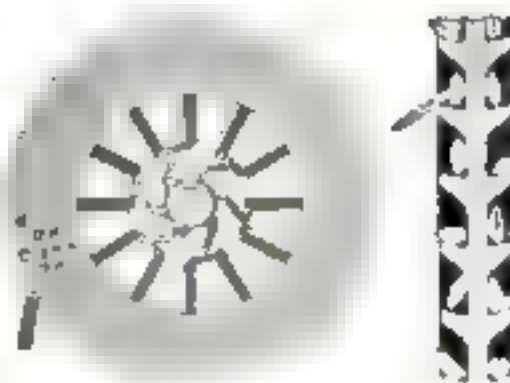
The new machine, called a "re-cleaner," consists of 15 aluminum disks set  $2\frac{1}{4}$  inches apart on a shaft rotating at 60 revolutions a minute. Each disk is slotted with a large number of undercut pockets, that act as sorters. Three sizes of pockets are used for making the separations. The grain to be cleaned is fed into the machine near one end and the small weed seeds and dirt are picked out of the mixture by the first disk containing smaller size pockets.

As the grain progresses through the machine, the disk containing the larger size pockets pick out the wheat kernels and leave the oats, wild oats, barley, and other material longer than wheat,



This material is discharged through the opposite end of the machine.

Fan shaped blades on the inner periphery of the disks move the grains along from



The above front and cross section views of one of the 15 sorting disks in the wheat cleaning machine at left show arrangement of pockets that catch the wheat kernels while excluding the longer weed seeds.

one disk to the other, until the grain emerges from the lower end as practically pure wheat. The gleanings are carried over and above the shaft and dropped into a small trough. In operation the fine seeds are discharged into bags on one side of the machine and the cleaned wheat into bins or wagons.

In one test, grain containing up to 38 per cent of weed seed was passed into the machine, reappearing as cleaned wheat, without visible traces of foreign grains.



### Crane Operator Rides with Load in Warehouse

**C**RANE operators in a San Francisco warehouse, ride with their loads on haul boatwain chairs suspended from the crane blocks. By being close to their work they are able to pile the huge rolls of merchandise more quickly and neatly.

The crane is equipped with an electric control with four buttons for raising and lowering the crane and for forward and reverse motion. The operator, seated on a crane seat with the control panel in his hand, can direct the crane and its load to any corner in the huge warehouse.

A pound jar of honey there is the concentrated essence of 80,000 flowers, and to take it the bees may travel more than 100,000 miles. One colony of bees will produce from 60 to 80 pounds of honey in a working season.

## Heated Air Improves Tone of Phonograph

**B**ASING his researches on the fact that sound waves seem to be purer and stronger when transmitted to the listener through a warm, dry atmosphere, Mr. G. Kitchen, inventor of the Kitchen rudder, has perfected a tone clarifier for phonographs.

The reproducing needle of the talking machine is connected with a diaphragm

that divides the sound chamber into two parts. One side is kept filled with gas by a connection with the city mains. The other side connects with a short tone arm and horn. From the gas filled compartment a short piece of tubing leads to two gas burners, which extend upward to the center of a series of sound reflectors.

When the machine is silent, the gas burns steadily, but if the diaphragm is moved by the needle traveling in the record groove, the pressure of the gas is varied. This action affects the heat of the air above the outlet of the sound chamber, producing for each note the most satisfactory atmospheric condition for its transmission.

It is said that the machine reproduces in remarkable detail the sounds of a voice and the fine tone shadings of an orchestra.

### Alarm Rings when Radio Detects Distress Calls

**B**Y MEANS of a new radio receiving instrument, distress calls from ships at sea can be detected automatically.

The new signal takes the place of the famous C. Q. D. and S. O. S. calls. It consists of four dashes of one second each, repeated three times at regular intervals. When this code is received by a vessel equipped with automatic instruments, the impulses pass through a tuning coil and then to four vacuum tube amplifiers, where they are enormously magnified.

After amplification the dashes pass through an electrically operated mechanism with ratchet wheels and lever arms. The latter terminate in dash pots for the purpose of giving the correct intervals between signals. The ratchet wheels comprise the "selector" and operate after the manner of the striking mechanism of clocks. An electric bell in the circuit rings when the distress signal is properly sent and received.

When the operator on a ship supplied with the device goes off duty for the night, he switches off his regular equipment and connects the automatic receiving set with the antenna.



Sounds from the tone arm, mellowed by heat from gas burners, are amplified by reflectors.



# Uses Deadly War Gas to Kill Bad Smells

**Yale Scientist Makes Remarkable Discovery that Chlorine Will Destroy Evil Odors that Cost Nation \$2,200,000 Property Loss**

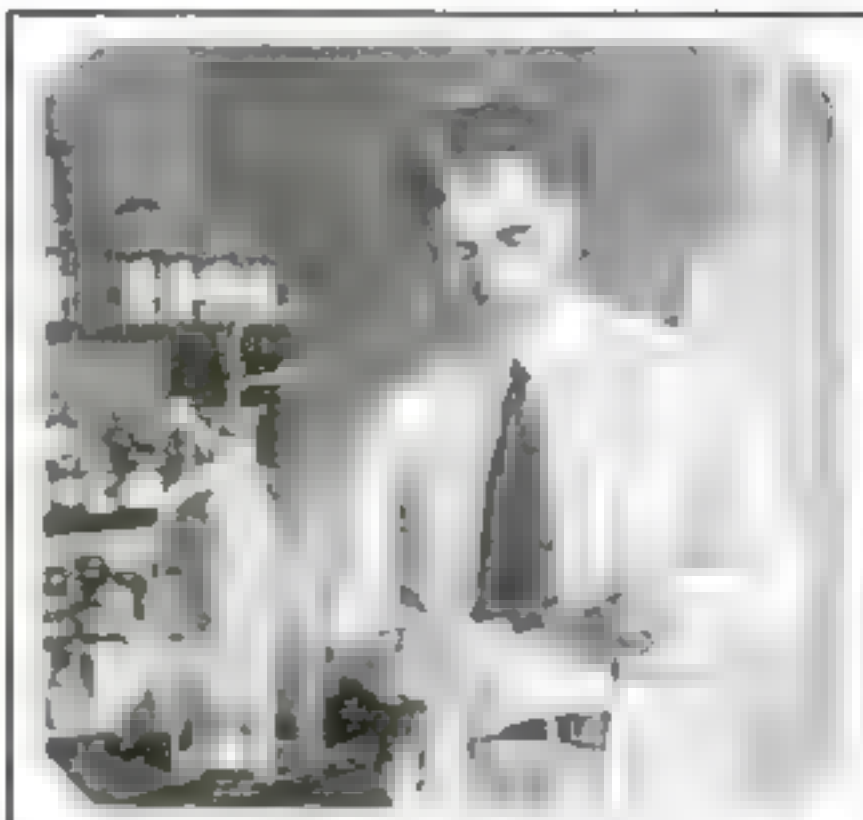
By Harry A. Mount

**WE** AMERICANS spend every year tens of millions of dollars for perfumes, scented cosmetics, and toilet soaps having an odor we like. But we spend many times that much to get away from odors we do not like. The actual property loss in the United States due to public aversion to certain odors is more than \$2,200,000,000!

It now appears that this loss is almost entirely avoidable. And it is chlorine—the same greenish gas which the Germans first used in warfare—that is now coming to the peacetime rescue of hundreds of thousands of sufferers within near range of stockyards, garbage plants, fertilizer factories, and similar industrially-necessary abominations. Chlorine, indeed, once a troublesome waste product in the manufacture of common baking soda from salt, is now finding many industrial uses. Great quantities of it are used in the textile industries for bleaching fabrics. Practically all of the white flour that goes into our daily bread has been bleached or "aged" with chlorine. And the water supplies of most of our cities are treated with chlorine to destroy harmful disease germs.

## Doctor Henderson's Discovery

Now a man who has made a life study of odors, gases, and ventilation—Dr. Vandell Henderson, professor of Applied Physiology at Yale University—has lately hit on the rather remarkable discovery that chlorine gas bears a particular grudge against organic odors and, indeed, cannot exist in the same atmosphere with an odor for more than a few seconds. In that brief time a chemical reaction takes place which not only destroys the odor, but the chlorine as well. Of course, it is possible to secure an excess either of odor or chlorine, but when the two are present in balanced proportions, both disappear, and the nose can no longer detect either of them.



## He Has Found a Use for the World's Worst Smell

**TO ILLUSTRATE** the astounding power of odors, Professor Vandell Henderson, of Yale University—who has the unique distinction of being probably America's leading expert on smells, gases and ventilation—is shown above holding in his left hand a test tube containing a small quantity of mercaptan, worse than the odor of skunks. So powerful is this innocent appearing chemical that the vapor from one drop would make the largest office building untenable.

Professor Henderson has recently perfected a method of using mercaptan to warn city dwellers when natural illuminating gas, which is odorless, escapes from ruptured pipes or burners carelessly left open. The mercaptan is fed in small quantities into the mains, where its powerful stench mingling with the gas permeates the entire system. All traces of the odor are destroyed when the gas is properly burned, but it will cause instant detection of a gas leak, and thus prevent many a fatal explosion.

The critical problems of ventilation confronting the builders of the vehicular tunnel under the Hudson River, were submitted to Professor Henderson and his colleague, Professor Howard W. Haggard, and their recommendations were embodied in the construction now under way.

Thus, from scientific research in the neglected and seemingly unimportant realm of smells, comes a discovery of enormous economic significance, affecting millions in property values and industrial processes.

The physical nature of odors is just as mysterious as the sense by which we detect them. It would be impossible to obtain even with agreement as to what a bad smell really is! Men of science who have been prying into the affairs of our common ancestors have discovered the scandalous fact that the smell—the ape-men liked best were the very ones we kick about to the Health Department today. There are actually millions of persons sharing this old globe with you and me who would like nothing better than to be able to step out on the front porch on a warm summer morning and take a whiff of the pleasant aroma from the Chicago stockyard!

## Odors Trouble Boston

I have referred to the Chicago stockyards because odorously they are the horrible example for the whole country. But there is hardly a city or town of considerable size in the United States that has not a similar problem to contend with. Even cultured old Boston has troubles of her own with odors. Says the Committee on Municipal and Metropolitan Affairs, in a recent report:

"Foul and nauseating odors have been present in Boston for many years, even before the present plan (for garbage disposal) was erected on Spectacle Island (in Boston Harbor).

"We quote below extracts from a bill of complaint filed in 1900 with Dr. Samuel H. Durgin, Chairman, of the Boston Board of Health, against the garbage contractor who were operating a plant at Dorchester:

"That said plant . . . has become a nuisance by reason of offensive smells and exhalations from the operations of said plant and said smells and exhalations are not only offensive, but are likewise harmful to all persons living in the neighborhood. Said smells and exhalations are offensive and unhealthy and said plant and business is a nuisance."

"We thoroughly agree with the statement of Doctor Durgin recited in the above complaint and believe that the same conditions prevail today in the plant on Spectacle Island."

## Science Classifies Smells into These Six Fundamental Odors



**SPICY**  
In cloves and pepper



**FLOWERY**  
In the rose and violet



**FRUITY**  
In vinegar and fruit juices



**RESINOUS**  
In fir and pine trees



**FOUL**  
Product of decomposed particles



**SCORCHED**  
In tarry and burned matter



Island, to a worse degree. Your committee is informed and believes that these odors are so strong and prevalent as to affect property values.

"These odors are noticeable over an area in which thousands of people work and live," the committee concludes, naming many points within a radius of five miles from the plant, where complaints have been raised.

The common belief that odors are unhealthful, as assumed in the foregoing, is erroneous. The latest scientific information is that the worst thing about an obnoxious odor is simply that it smells bad. If an odor is very intense, and is spread over several square miles of territory, it consists at most of but a few ounces of material. The amount that excites the sense of smell is so small as to be infinitesimal. Nevertheless the damage to property from smell-producing plants is tangible and enormous.

Probably the man most competent to estimate this is W. J. Springborn, of New York, who believes the loss in the United States chargeable to odors totals not less than \$2,200,000,000, or about \$20 per capita.

Mr. Springborn has been fighting odors for many years, and has spent thousands of dollars in various attempts to get rid of them. At one time, in Cleveland, he built a big double-decked scrubbing chamber of brick, 43 feet long, 19 feet high, and eight feet wide. The odorous gases were passed twice through the entire length, in a constant spray of water, over and under 17 baffle walls in the interior. The gases were then passed into a specially constructed furnace in which natural gas was burned to consume any odors not condensed by the water spray and the baffle walls. According to Mr. Springborn, the odors eluded completely the traps he had set and the only effect of the furnace was to send the odors higher into the air, spreading them over a wider area. Later, in Chicago, Mr. Springborn put to a thorough test the idea of spraying the material from which offensive odor arises with disinfecting solutions, with results equally unsatisfactory.

The chief reason for this failure, and many others like it, is our very incomplete knowledge of the nature of odors. Ransacking every index in one of the best technical libraries in the world, I found one book describing in vivid detail the smells to be encountered

## You Don't Smell with Your Nose

DO YOU know why you have to "snuff the air" when trying to detect a faint odor? It is because the nerves governing the sense of smell are not located, as is generally supposed, in the nasal passages, but in an area of sensitive membrane about the size of a dime and located high above each nostril.

A portion of the hairlike tips of the olfactory nerves terminating in this membrane receives the sense impression and conducts it to the brain. Because of the position of this membrane outside the natural path of the breath, it is necessary to draw aside a current of air by snuffing before the exact shade of an odor can be determined.

The effects of snuff and smelling salts have nothing to do with the sense of smell. They react only on the linings of the nasal passages.

So far as physiologists have been



able to learn, smells are pigeonholed in the brain as visual impressions. Each smell carries associations good or bad and these associated images are brought forth by the brain when particular nerves are excited.

The reaction of the brain to an odor depends also to a large extent on the sense of taste. Only by combining the brain reports of these two senses can odors be accurately catalogued.

Degenerate as the olfactory nerve sense in man has become through evolution, it still retains the marvelous ability to detect one part of camphor in 400,000 parts of air and one part of vanillin in 10,000,000 parts of air. As for the obnoxious smell mercaptan, the human nose can detect the presence of one part in 25 trillion parts of air.

about the size of a dime, covered with small, tongue-like projections, in which the nerves of smell terminate. This sensitive tissue is called the "olfactory epithelium."

An ordinary breath does not pass directly over this membrane. But when we draw air through the nose, it jerks and pulls when we

sniff, in other words, a little whirlwind is created that reaches the sensitive membrane, carrying to it the minute odorous particles that give us the sensation of smell. The lining of the nose itself is served by an entirely different set of nerves, which, when irritated, merely set us sneezing.

The sense of taste, as we ordinarily use the term, is largely dependent on the sense of smell. Do you realize that if you had lost your sense of

left last  
did not  
your  
morning?

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how fond  
each time.

no wine or shall  
old regretful mem-

plete his satisfaction

g, he had drawn a little

thousand exhaled it through

there are few tastes

the power exception of

are not affected by the

the nose--and not our

selection of most of

the price we are willing to

pay and our final

enjoyment of it.

But in spite of

the fact that our

noses are not now

as useful as they

once were, our

olfactory epithe-

lium remains a

marvelously sen-

sitive organ. The

in Paris and four or five short articles describing some obscure and rather inconclusive experiments. It was then that I went to Professor Henderson—who won't object, I hope, to my calling him a world authority on smells—and from him I obtained most of the information that follows.

The sense of smell is the most delicate of the human senses. It is the only sense that is not affected by the passage of time. It is the only sense that is not affected by the passage of time. It is the only sense that is not affected by the passage of time.

Something  
you have  
lost it  
The  
we  
or



Above, the simple mechanism by which chemicals are automatically injected into the air, neutralizing all trace of the objectionable smell. A few cents' worth of chlorine a day will deodorize the refuse from an entire city.



Formerly unbearable to near-by residents, the vapor from a garbage reduction plant at New Bedford, Mass., has been so purified by chlorine, that a man can stand directly in its path without noticing the smell.



## Ingenious Scaffolding Slung from Mine Roof



**F**ACED with the immediate necessity of removing loose rock on the 157-foot ceiling of a mine, E. W. Campbell, of Bonneterre, Mo., devised an original

system of hanging scaffolding built out in short sections from the side wall.

Standing on a shelf at one side, a crew of three men drilled holes diagonally into the



The peculiar construction of the plank platform which miners used when removing tons of loose rock from the 157-foot mine ceiling at the left, is explained in the sketch above.

top of the slope or ceiling for the eyebolts.

After the eyebolts were in place, the rods eight feet long were hooked into the protruding eyes. The bottom ends of the rods were tied together with side rods  $3\frac{1}{4}$  feet long. Oak planks were laid from the shelf out to the side rods, but instead of being merely long enough to hold the tie rods vertically, longer planks were used so that the rods were pushed forward and hung at an angle. The planks were secured to the side rods by U-bolts.

years, without losing perceptibly in weight, and thus seemed to prove that the odor could not be a material emanation.

But the fact is now fully established that a smell really is a material thing. And scientists at last have discovered the actual substances that cause the best known odors, and the amount of each that must be in the air before it becomes perceptible. Thus, we can smell hydrogen sulphid—the smell characteristic of bad eggs—when it mingles with the air in the tiny proportion of one part to 100,000,000! Roughly, this means that a thimbleful of hydrogen sulphid released in a six-room bungalow would render the entire place uninhabitable.

### A Mental Obstacle

The secretion of a certain gland of the skunk is so powerful that a drop of it would be sufficient to malodorize the whole interior of the Woolworth Building. Realize that, and you will be ready to hurdle a mental obstacle that hitherto has prevented men from stamping out the nuisance of evil smells.

To illustrate this mental habit, think for a moment of our reaction to sound. When we hear piano music, we think not of the minute vibrations that are actuating the delicate organism of the ear, but of the vibrating strings of the instrument, or, more likely, of the nimble fingers of the musician. And so with odors, when we get a whiff of the emanations of fermenting garbage,

we think not of the infinitesimally small amount of material that is stimulating the olfactory epithelium, but of the garbage pile itself. Our first impulse is to get rid of the garbage pile, and although there may be tons of the offending garbage, that is nearly always the suggested remedy.

Would it not rather seem the sensible thing to get at those few ounces of odorous emanation at the source and kill them, than to try to treat tons of material that cannot very well be got rid of? And this is what Professor Henderson has done. His atten-

tion was first drawn to the problem of odor elimination when a fertilizer manufacturer appealed to him for help in getting rid of odors that were annoying neighbors. He began a long series of experiments that finally demonstrated that chlorine gas, mixed with the odorous gases in the proper proportion, caused a chemical reaction that completely and permanently destroyed both odor and chlorine.

After some preliminary tests in a Cleveland reduction plant, which served to show the relatively small amount of chlorine needed, a working unit was installed to kill odors from a dryer in the municipal garbage reduction plant at New Bedford, Mass.

### Chlorine Conquers!

In a series of extremely severe tests, not only did the chlorine completely eliminate the garbage odors, but likewise such pungent smells as come from burning feathers, hair, wool, leather and putrid fish. This plant has been so equipped now for several months, and there has been no complaint about odors. The chlorine consumption is less than eight pounds a day, costing but a few cents. Since then a number of other plants have been similarly equipped, and with equally good results.

Under the magic of modern science, a dozen or more of the olfactory plague spots in Eastern states have already disappeared, to the relief of some thousands of sensitive noses.

## Vast Business Built on Sense of Smell

**A**MERICANS spend tens of millions of dollars annually for perfumes, cosmetics, and other scented preparations, according to figures from the United States Department of Commerce. This amount, compared with our \$95,000,000 bill for coffee, indicates how substantial an economic rôle the sense of smell plays in our national life.

From the perfume industries of Europe comes every year nearly \$4,000,000 worth of distilled oils to be made up into toilet preparations and sold for many times their original cost. Musk, which is the secretion found in a gland of the musk deer, costs perfume manufacturers nearly half a million dollars a year.

Since the war, America has added to her own resources by producing large quantities of synthetic perfumes made from coal tar; but most of the finer essences are still obtained from foreign countries.

None of the essential oils is attractive in itself. It is only by combining the raw, and often evil smelling, substances into blends that the perfumers obtain the rare and costly perfumes now so widely used.



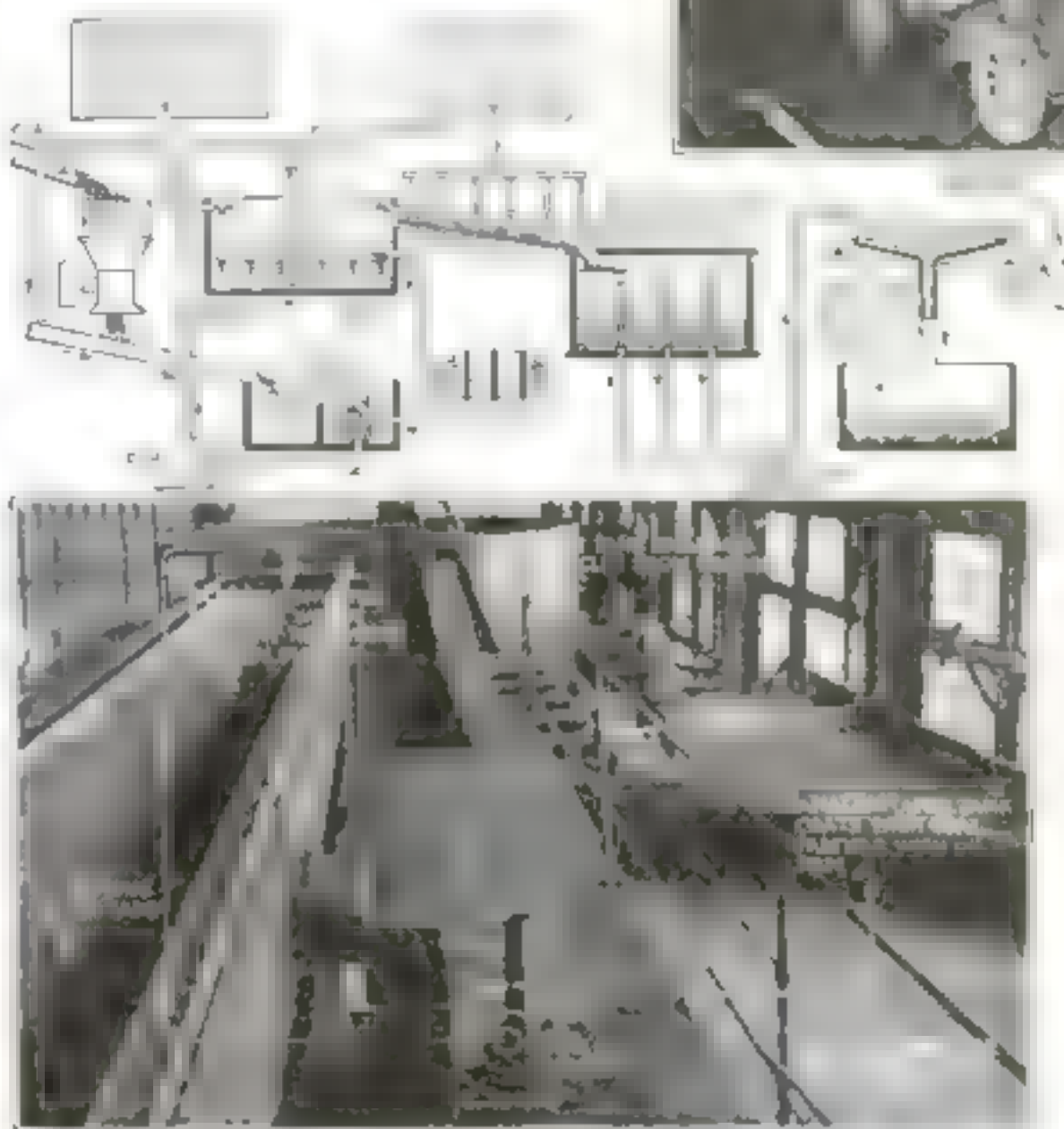
# Plastic Fuel May Solve the Nation's Coal Problem

**PLASTIC** fuel, or "amalgam," as it is called, is now added to America's fuel resources as an intermediate form between liquid and solid fuels by the invention of a new method for combining waste petroleum oils of all sorts with waste coal to make a most satisfactory product. The inventor, Walter E. Trent, was formerly of the United States Bureau of Mines.

A plant at Alexandria, Va., is already producing many tons of the new fuel daily, and there are indications that the present fuel emergency will prove the nationwide importance of the new process. It makes available for immediate consumption, for example, the great waste piles that are seen by the mouth of every mine in every coal field, some of them representing accumulations of half a century. It has even been suggested that the treatment of municipal ash dumps is entirely feasible.

In principle, the process is simple. Wet pulverized coal suspended in water, when treated with from 30 to 40 per cent as much oil as there is coal substance present, agglomerates into a pasty plastic mass in which all the valuable coal substance and the oil join. The "ash," or mineral matter, which has been mechanically separated from the coal particles by fine grinding, does not go into the coal-oil mass, but remains suspended in the water and can be separated from the fuel paste almost perfectly. This produces an excellent fuel

that is practically free from water and relatively low in ash content. In a few cases the amount of ash can be reduced below one per cent of the treated fuel.



The Trent process for combining waste oils and grades of coal now considered valueless is explained in the diagram and the photograph

Accordingly, the process consists of reducing the coal to powder in a crusher and a pulverizer and then agitating the powdered coal with water and oil. The oil has an affinity for the small particles of coal

When the large plant now building is in full operation, it is expected that thousands of tons of product will be available each day, surpassing by from 40 to 60 per cent in heating efficiency the best steam coal.

and the water prefers the mineral particles, with the result that the worthless ash is eliminated in the form of a fine mud, while the finely divided coal-oil mixture is deposited in a granular form. These amalgam granules are washed to remove any mineral matter that may adhere to them and are finally dried in the air. They are then found to be as good, that they can be handled like pea coal.

Practical tests have shown that for best results the crusher should reduce coal to a size that will pass through a screen of 200 mesh to the inch. Anthracite coal is the best for the purpose, after that come bituminous and lignite.

## Whirling Mold Casts Fourteen Iron Pipes Every Hour

**IRON** pipe said to have a tensile strength twice as great as pipe made in the ordinary sand molds is now being manufactured successfully by a revolutionary French process that makes use of centrifugal force.

The pipe is formed by pouring molten metal from a hopper into a chute which leads to a rotating, water cooled mold having an inside diameter equal to the outside diameter of the desired pipe. A flare and core at one end provide for the bell and for the undercut channel which takes the lead when two sections of pipe are caked.

As the molten metal strikes the cool mold, it is distributed by the

rotative force and then cooled. The mold is slowly moved away from the chute as the pipe is gradually built up to the required length. When the metal cools, the shrinkage is just sufficient so that the

pipe may be removed easily from the mold.

Machine made pipe weighs less than sand mold pipe of the same dimensions and is more resistant to shocks and bending. The metal is more homogeneous and produces a clean wall inside and out with a remarkable uniformity of thickness throughout the pipe.

By this process a gang of 25 men is able to turn out 800 lengths of pipe a day with no material necessary except molten iron, while under the old system of sand casting 80 men could produce only 400 lengths in the same period, with the added cost and labor of molding and core making.



Above, the pipe has been removed from the machine. Right, a simplified diagram



# Daring Airmen Locate Seals for Fur Hunters

WITH his airplanes especially rigged for winter flying, Maj. F. Sidney Cotton, of Australia, is preparing for another rigorous season of reconnoitering for herds of seals off the coast of Newfoundland and Labrador and wire-leasing their positions to seal hunting expeditions.

Every year thousands of seals float down to the Newfoundland coast on great blocks of ice carried along by the arctic current. Specially constructed ships sail from St. John's, Newfoundland, to find the seals and slay them for their fur and oil. Sometimes they are successful in locating the main herd, but often they have failed.

Major Cotton's method has been to fly over the arctic current and watch for the colonies of seals.

When he spots a group, the pilot gives the bearing by wireless to hunters on the mainland. The hunters set out in their sharp prowed vessels until they reach the herd. Usually the older seals escape into the water, but the baby seals are killed in huge numbers by hunters equipped with clubs. Besides their sealing activities, Major



Above: the crew of a sealing ship is seen in airplane view as they leave the vessel to slay the seals

Cotton and his associates are official letter-carriers for the province. The difficulties of this type of flying are tremendous.

Two of Major Cotton's seal hunting planes are shown above ready to take off from the ice

mendous. Landings must be made on ice or deep snow and the engine must be protected against freezing, since the temperature is rarely warmer than 20 degrees below zero. By means of an anti-freezing solution for the circulating system, a radiator protector, patented landing skids, and a vacuum suit for the pilot and observer, Major Cotton has been able to continue his flying under conditions that have proved the main channels of communication.

The absence of airplane stores near Newfoundland makes it necessary for Major Cotton to carry on hand everything that can possibly be needed for repair and replacement. Yet in spite of all these drawbacks the success of his novel enterprise during the past year has warranted the use of two more planes during the coming sealing season.

## Steel Rackets and Masks for Tennis

TENNIS rackets made of metal and wire masks that protect the eyes of sportswear players are two tennis innovations of the season.

The hollow steel racket frames are bent into shape at the rate of 600 an hour by special machinery perfected by a New Jersey firm. Instead of gut, the rackets are strung with fine steel strings said to give longer life and greater resiliency.

In manufacturing the frames, the tubing is placed against a curved form, while rollers moved by an eccentric cam roll the metal around the form. The second operation consists in placing the

bent forms on the same machine, but with rollers of different sizes that further curve the tubing to the correct dimensions. After other machines have woven the steel strings back and forth between the outside frames, the racket is completed by the addition of a standard handle grip.



How tubing, drawn around a form, is shaped into a tennis racket



A player wearing a protective mask and wielding a steel racket



## Brood of Hummingbirds Can Nest in Spoon

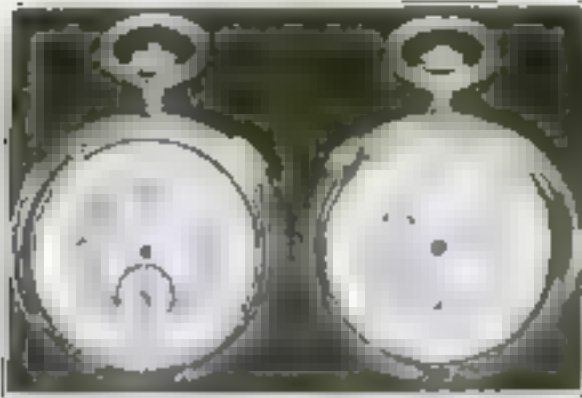
BABY hummingbirds are so amazingly small that an entire brood can nestle in a teaspoon, as demonstrated by a photograph recently made by A. A. Allen, assistant professor of ornithology at Cornell University, and reproduced above. The mother bird is little longer than the bowl of the spoon.

More than 400 species of hummingbirds, among them the smallest and most beautiful birds in the world, are to be found in America. The largest of these measure 8½ inches; the smallest less than two.

Hummingbirds live on a mixed diet of insects and nectar which they obtain from flowers with their slender and extensible tongues. In destroying harmful insects they are useful to man, yet they are rapidly becoming extinct, because they are so eagerly hunted for their plumage.



## Many Instruments in One Small Timepiece



The two faces of the timepiece

**I**NCLUDING in its double faced case two watch mechanisms, a barometer, an altimeter, and a compass, a timepiece originally made for the late Charles I of Austria is said to be the smallest precision instrument in the world.

One side of the watch contains a dial with luminous figures and an alarm indicator that can be set for any hour. A barometer for predicting wind and rain, an altimeter for recording altitudes up to 8000 feet, and a compass.

On the other side is a split second dial measuring time in one fifth seconds up to 30 minutes' duration. In addition, there is a repeater gong operated by a minute pushbutton which strikes the hours, quarter hours and minutes.

All of these mechanisms are contained within a diameter of 2 3/4 inch.

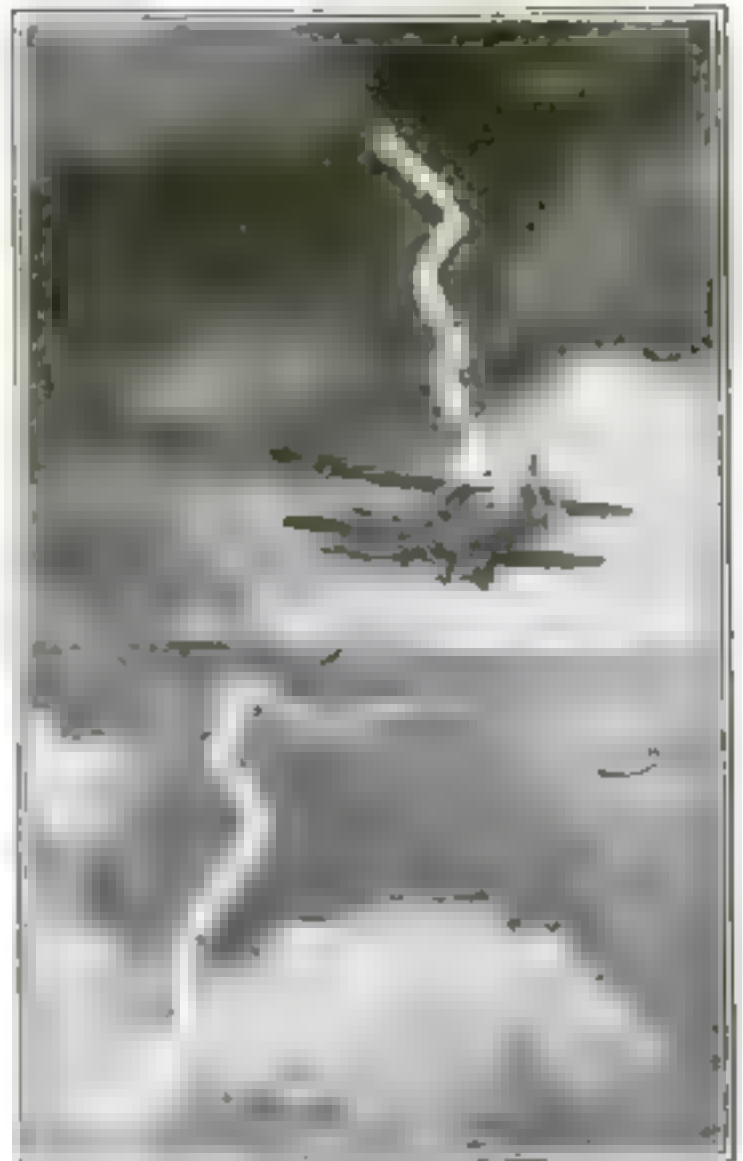
## Flying Plane Survives Lightning Bolt

**S**PECULATION on the possible fate of an airplane struck by lightning while in the air has been set at rest by the experience of Capt E. D. C. Herne, whose plane was recently hit by a bolt while halfway across the English Channel on a flight between London and Paris. The plane was unharmed and neither Captain Herne nor his mechanic suffered discomfort.

While steering his ship around the edge of a thunderstorm area, Captain Herne was startled by two blinding flashes. The edges of the wings were brilliantly outlined in green and yellow. The plane trembled and rocked for an instant, then quickly regained its balance and continued on its way.

### Why Bolt Passed On

It is believed that the plane chanced to pass into the direct path of the bolt, but escaped disaster because of the lack of connection with the earth. The plane, with its content of metal, afforded a halfway stopping point for the discharge, but the flash lasted so short a time that the metal did not become heated. After spreading on the surface of the wings, the bolt again concentrated and proceeded down the trailing wireless antenna to the water beneath.



The lightning, after striking the plane and illuminating its edges, followed the radio antenna and leaped to a cloud at a lower level.

## Ore Machine, Aided by Magnets, to Stretch Our Iron Supply

**C**ONCERNED about the probable exhaustion, in perhaps 20 years, of the high grade iron ore beds of Minnesota, from which more than half the iron mined in the United States is obtained, Professor Edward W. Davis, of the University of Wisconsin, has developed an ingenious method of utilizing electromagnets to act upon low grade ore hitherto considered almost valueless.

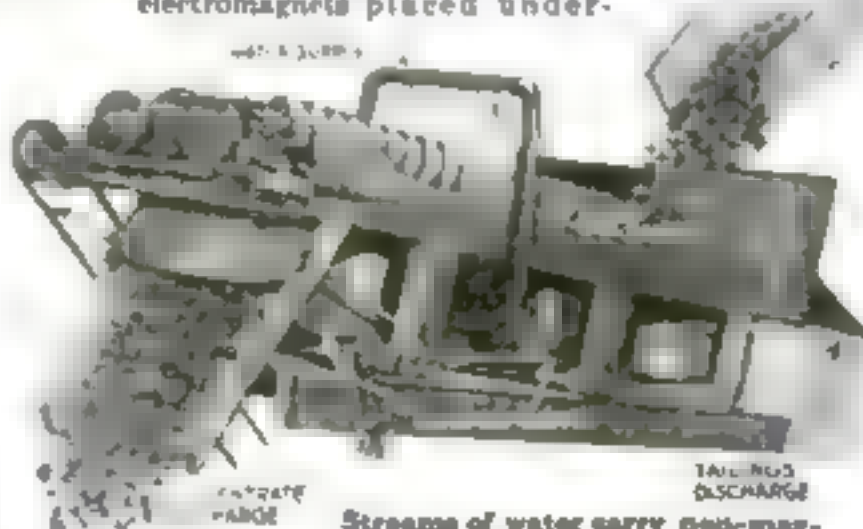
### Utilizing Low Grade Ore

His device, known as the "magnetic logwasher," is expected to make profitable the mining and merchandizing of enormous deposits of low grade ore—hematite and magnetite—in the Mesabi range of Minnesota. The ore, averaging about 25 per cent iron, is run through crushers that by a series of operations automatically eliminate the non-magnetic parts of the ore. The partly concentrated ore, which consists of fragments the size of peas, is then pulverized in ball mills—large revolving cylinders containing steel balls of different sizes. These balls act like grindstones and quickly reduce the ore to a fine powder.

The final concentration is accomplished in the logwasher which, like the crushers, separators, and pulverizers, work automatically. This device consists of a long sluice box, supported in an inclined position. Through the entire length of the box runs a shaft to which spirally arranged scrapers are attached. The pulverized ore is fed into the inclined trough at the lower end,

while from the opposite end is admitted a stream of water that floods the lower part of the trough, washing away toward the overflow gate the non-magnetic tailings. The small particles of magnetite are attracted by three sets of powerful electromagnets placed under-

neath the trough and are automatically pushed toward the higher part of the trough by the rotating scrapers, to be discharged in the form of mud-like paste through a gate provided for the purpose. This magnetite paste is fed into a machine in which the water is removed and the mass fused into a solid concentrate containing about 64 per cent of iron, which may be shipped to the furnaces.



Streams of water carry non-magnetic particles to rear of machine, while magnets hold the iron.



This map shows location of low grade ore deposits made available by the "logwasher"

### Hematite also Is Used

The same process may also be applied to the concentration of hematite, another low-grade iron ore, also found in Minnesota in enormous quantities. In its natural condition hematite is not magnetic, but if part of the oxygen contained in it is driven out by heating, it becomes magnetic and may then be concentrated, like magnetite ore, in the magnetic logwasher.

The method invented by Professor Davis has been tried for several years in an experimental plant at the University of Minnesota and later in a mill built for the purpose at Duluth. Now a plant, which will cost about \$3,000,000, near  
con-  
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ores of Minnesota, one of the great iron producers, will be secure.



# Boys Build Self-Propelled Model of Famous Ship

**R**IVALING all previous achievements in model boat building high school students of Pasadena, Calif., have completed a 10-foot working model of the famous transport Yale, now in the constant passenger service. The model is complete to the tiny recessed mainmast and intricate details of the hull.



When launched at Los Angeles, the model ship rode the waves with perfect balance.

As the boys built the hundreds of state-made parts have been carefully inspected. Many of the boys and wireless antenna are made of the same material. The model is a perfect copy of the original.

Before completing work on the model, the exact measurements of the Yale were obtained. These measurements were scaled down to the

proportionate size. The hull was built of sections of wood and the machinery placed in it. While the model was being completed, other members of the group were finishing the superstructure with all its details.



Propelling machinery consists of storage batteries and small electric motors on each propeller.



Boys working with simple tools duplicated graceful curves of the vessel's hull.

## Rotary Electric Ovens Toughen Auto Parts

**R**OTARY electric furnaces, used to heat-treat automobile parts, have demonstrated marked advantages over oil burning furnaces because of the continuous operation and the perfect control of temperature, heating time, and rate of heating obtained through their use. The electric furnace practically eliminates scale. Material annealed requires only a brief "pickling" in acid instead of the usual three hours of soaking.

Walls in the electric furnace are of standard construction, but the hearth is made of a ring that rotates constantly during the heating period. Each furnace has two adjacent doors, one for charging and the other for discharging. A baffle plate set between the doors prevents the rush of cold air from striking and chilling the heated pieces when the furnace is being

charged. The hearth, supported on twenty roller bearings, can be rotated at any one of six different speeds.

Two sets of nickel chromium ribbon, mounted on the inner and outer walls of the frame, supply the heat. The first set is the larger and extends two thirds of the distance around the circumference. It consumes 210 kilowatts of electricity. The smaller set, designed to radiate 60 kilowatts in heat, makes up radiation losses and provides enough additional heat to bring all material out of the furnace at the same temperature.

Normally the temperature of the heating zone is held at 1580 degrees, and that of the finishing zone at 1525 degrees, but both of these heats are varied slightly, according to the material to be treated. Any temperatures between 200 and 1900° F. may be obtained.

The number of pieces, the proper speed of rotation, and the temperature for each



After adjustment of automatic devices, this revolving oven anneals auto parts without further attention. Coils of metal ribbon wound on huge spools and heated by electricity maintain the correct temperature in the ovens.



## Old Tires Are Quoits in Totem Pole Game

**U**SING a symbolic totem pole as the goal, and worn out tires as the quoits, the city of Austin, Texas, has arranged a game of quoits that brings in revenue to the local Red Cross organization.

The pole, erected in the center of a busy thoroughfare in front of the state Capitol, is usually so well hidden by donated tires that its weird carvings are invisible. At the base of the pole an American eagle is illustrated with its claws on the spikes of a helmet and at the top is the shield of the Red Cross held tight in the claws of a lion.





# Why We Grow Bald—and How Not To

## New Medical Knowledge Makes Baldness a Case for Scientific Treatment Rather than Barber's Tonic

By Chester T. Stone, M.D.

**B**ALDNESS is definitely on the increase in the United States, and is more characteristic of the American than of the European, according to recent observations by the medical profession. In the large cities of the United States it is to be found a greater percentage of prematurely bald heads than in any other region on earth.

Strange as it seems, the average American business man's effort to maintain an attractive personal appearance is perhaps the most plausible reason for his developing, against his wish, this defect in appearance. The greatest proportion of baldness is found among the more fashionable of professional and business men. Men of this type make frequent visits to barbers, where the sensitive scalp and hair cells are exposed to brushes and combs that are too seldom sterilized. Infection results and the damage, usually commencing with the appearance of dandruff, has been done.

### Bald-Headed Classes

Further proof that too much unscientific attention to the hair is harmful may be found in statistics revealing the frequency of baldness in various occupational groups. Among mechanics and industrial workers whose social position demands cleanliness, but whose business calling requires the performance of dirty work, are numbered almost as many bald-headed persons as in the professional group. Day laborers show a decreasing frequency, in almost direct proportion to the amount of time spent at barbers, while vagrants are very seldom bald. Daily exposure to the stimulating effects of sunlight may also be supposed to account in part for the healthier growths of hair characteristic of the latter two groups.

Baldness claims fewer women than men. Although women expose their growth of hair to the implements of hairdressing parlors, there is but little danger of contagion, because of the thickness of the growth, which prevents germs from reaching the hair roots.

In spite of cure-alls, medicinal fakes and hair restorers sold by the millions of gallons, baldness is on the increase in the large cities of the United States. Proper treatment with drugs, massages, and electrotherapy using ultra violet light rays are proving effective in many instances. But because of the fact that the baldness

### Do You Know These Facts about Your Hair?

**I**F A hair is removed from the scalp, four years are required for the hair bulb under the skin to grow another.

Normal, healthy hair is strong and elastic. It will stretch a third of its length, and will support 2 to 4 ounces.

It takes 15,000 red hairs, 105,000 brown hairs or 150,000 blond hairs to cover a scalp. The difference is caused by their relative fineness.

Grayness of the hair is caused by a hardening of the skin, which plugs the glands, preventing the secretion of the pigment that gives the hair its color. In gray hair the pigment cells have been replaced by air pockets.

Constant sea bathing is now said to be one common cause of baldness. The salt

water evaporates rapidly, leaving the hair dry and hard, and covered with a layer of deposited salt. To prevent baldness, some experts advocate thoroughly washing the hair in pure water after each plunge, and then rubbing in about a teaspoonful of olive oil.

The hair should not be washed more frequently than every two or three weeks, to remove the dirt, the dead outer skin and the excessive oil. Too frequent washing, or wetting of the hair before brushing, dries up the glands supplying the flow of oil, producing first grayness, then baldness.

Good general health is essential to the preservation of a flourishing head of hair. Worry and overwork are undoubtedly indirect causes of baldness.



Man's Chief Glory?

That man's hair can grow almost as luxuriantly as woman's is suggested by the hairdressing achievements of the famous baseball club representing the Israelite House of David of Benton Harbor, Michigan. In common with the other men of their sect they have boycotted the barber since boyhood.

### Ultra-Violet Cure

Diseases of the scalp that cause baldness are often being cured, in many cases, by rays from ultra violet lamps of this type.



follicle is a sheath surrounding the hair near the surface of the skin and terminating at its lower end in a small pouch containing the hair bulb or papilla. This conical shaped bulb, embedded in the skin, is filled with a soft, delicate pulp composed of blood vessels and nerves.

When a hair is forcibly extracted, some of the pulp adheres to its lower end and is erroneously supposed to be the root. If a hair is removed, its root remains and soon produces another hair by means of secretions from the bulb. As one layer of the hair shaft forms, it is pushed upward by another layer forming underneath. Microscopic glands opening into the bulb supply the growing hair with the pigment that gives it color and a lubricant that keeps it supple and firm.

### Analyzing a Hair

By treating a specimen of hair chemically it can be made transparent for examination under a powerful microscope. Examination reveals three distinct layers, one within the other, and each with a distinct function. The inner tube conveys the nutritive element from the hair bulb, the middle layer transmits the coloring matter, and the outer

coating is for protection. When this delicate arrangement of the hair cells is considered, it is not surprising that the careless attention given to the hair of the scalp is producing a bald-headed nation.

Baldness affects more than mere appearance. Besides being a conspicuous blemish a denuded scalp is also an indication of impaired health. Furthermore, since hair is a poor conductor of heat, it helps to maintain an even body temperature, protecting the body from chills in winter and

may be due to several combined causes, every case should be diagnosed by physicians specializing in diseases of the hair and scalp.

Many dollars spent for patented preparations on incurable cases can be saved and the treatment of curable cases made more certain of success by a knowledge of the hair and the skin in which it grows. The visible part of the hair is a shaft that develops under the surface of the skin into a root structure called the follicle. In the







## Steam Roller Runs New Pavement Breaker



A steam driven piston, exerting a force of four tons, drives the picks of the scarifier through the toughest pavement

**S**IX tempered teeth forced into old street paving under steam pressure comprise a new attachment, or scarifier, that can be added quickly to the rear of any road roller. The movement of the scarifier is under the control of the roller operator.

The teeth are held at the ends of arms extending from an angle iron attached to the steam roller frame. A steam cylinder placed in the center of the gang is used to raise and lower the teeth. By means of the piston of this cylinder, controlled from the

cab, the picks can be forced into the surface with a four-ton pressure, or they may be lifted at will for crossing pavements and manhole covers. Gauge rollers located just forward of the teeth prevent the latter from penetrating too far if the rear wheels of the roller happen to drop into a depression.

Both the length of the teeth and their spacing can be quickly adjusted by means of the clamps. By setting the picks at their maximum spacing, a cut of 56 inches can be made.

## Three-Ply Metal Formed by Electrolysis

**J**UST as the strength of wood is increased by combining several thin layers or plies, sheet metal can be reinforced by forcing together two or more layers of different metals.

A new method is by electrodeposition of copper on mild steel. The steel is first perforated and then thoroughly cleaned for the plating process. After a certain period in the bath, the copper deposits on the sides become connected by the deposits

through the perforations. The final product is then placed in a mill and rolled to thickness.

Three-ply metals formed in this way are used in making containers where additional strength is essential without an increase in thickness of the walls. Lead covered steel plates have also been made by this method, although with these two metals more exact work is required to insure a perfect union between the surfaces.

## Map Tacks Keep Tabs on Fire Apparatus

**C**LOSE tabs on the movements of fire apparatus in Boston is maintained by a comprehensive system of map tacks and cards located at the fire headquarters. By means of the map it is possible at all times to exactly locate fire fighting apparatus, whether it is in action or laid up for repairs.

Each fire company of the city is represented by a pin from which dangles the number of the apparatus. When an alarm comes in, the operator takes from a file the card representing the alarm box. On the card are the numbers of all companies that are slated to respond to that particular call. The operator notes the numbers and removes the tags from the respective hooks to the board at the right. If a second alarm is turned in, he adds the tags on the row below.

To make possible the use of both hands in moving the tags, the card representing the alarm box is gripped between the jaws of a paper clip.

In large cities, particularly during big fires, often an alarm comes in for a fire company that is at the scene of another fire. When this occurs, the operator inspects the map and selects apparatus that is nearest and best fitted for the work and dispatches it to answer the alarm.



When an alarm comes in, the tags are removed from the map to the board at the right

## Blast Furnaces Burn Stumps from Logged-Off Land

**E**CONOMIC clearing of logged-off land is made possible by an improved stump-burning process, which has recently been thoroughly tested by the Oregon Agricultural College. The new system is expected to add many thousands of acres to America's farm lands.

A small furnace or stove, open at one end, is placed against the stump and a fire kindled. Then the furnace and stump, with the exception of a small space opposite the stove, are banked in with sod. Draft is supplied through a two-inch pipe embedded in the sod, thus forming a blast furnace against the stump.

The flames eat directly through the stump, after which



Banked with sod, the furnace around the stump is supplied with draft through a two-inch pipe embedded in the sod

another hood is placed over the outlet and banked with sod. The stovepipe is removed, and the furnace is taken out entirely. The sod now forms an airtight stove and the stump burns without further attention, except the occasional sodding of apertures in the walls.

By this method, a large stump can be burned through in from 24 to 30 hours, and in 40 hours more the portion of the stump above ground is entirely consumed. The fire feeds itself, the stump gradually sinking into the crater and being devoured by the flames.

Results of the tests indicate that with many fires burning, large tracts may be cleared in a comparatively few hours.



# Sprinkling Can Tests Soil for Flood Prevention

**SPRINKLING** experiments, in which rainfall effects are artificially produced from ordinary garden sprinkling cans, may be used to determine data on flood run-off and soil absorption. Such investigations, instituted by flood prevention engineers, have been found to give highly satisfactory results.

The experiments were carried out on isolated plots, five feet square, surrounded by sheet iron boundaries, which extended 20 inches below the surface and four inches above it. The soil within the plots was not disturbed. These plots, which communicated by means of drainpipes with galvanized iron tanks, four feet deep and 18 inches in diameter, were located on level ground and on hill-sides, so as to determine the effect of level, slope, and nature of the soil



As the sprinkling can produces "rainfall" on each five foot plot, an observer measures flood run-off in the drain tank

upon absorption and run-off.

In producing artificial rainfall, the sprinkling can was filled with a measured volume of water that was evenly distributed over a plot within a specified time. Duration of the "rainfall" and the volume of water precipitated were carefully recorded, as well as the exact time of the beginning and the ending of the surface run-off into the drain tank and the volume of water collected in the tank.

It was found that the rain absorption by loose loamy soil is much greater than that by heavy clay soil and that cultivated soil and sodded ground absorb water more readily than hard and uncultivated soil containing comparatively little organic matter. The slope of the ground was found to have little influence on flood run-off.

## Lifters Frozen into Heavy Cakes of Ice

**FREEZING** special lifters into cakes of ice becomes economical where 1140 400-pound cakes must be lifted every day, as has been discovered in an ice plant at Cleveland, Ohio.

Instead of lifting the heavy cans in which the ice is frozen, iron lifts are lowered into the water before the freezing begins, and when the cakes are solidified 48 hours later, special pneumatic lifts haul out three cakes at a time. The lifters are made of hollow pipes, so a workman can loosen them later by connecting a hose with a double nozzle that circulates warm water through them, in that way thawing the incasing ice.

Since the cans need not be moved, the freezing process is expedited by attaching a

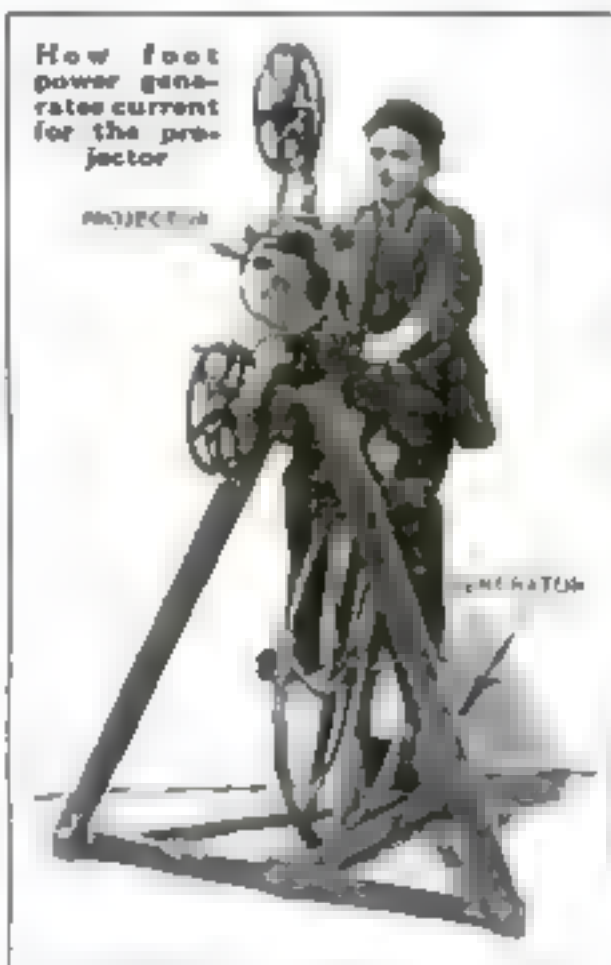


Hot water loosens the lifters, made of hollow pipe, from the ice

permanent fresh water inlet to each can, and connecting an outlet with the center of the bottom for the purpose of drawing off the impurities in the water, which collect in the heart of the cake as freezing progresses. If it were necessary, ice almost free from germ and sediment could be frozen from dirty water.

How foot power generates current for the projector

PROJECTOR



## Operator Pedals Movie Machine like Bicycle

**A** MOTION picture projector, for which the operator generates his own electric current by pedaling a large wheel as if he were riding a bicycle, has recently been invented in France for use where no current is available. A belt from the same wheel leads to the projector and cranks the

Thanks to a highly efficient electric lamp with a concentrated filament and a specially designed dynamo, the amount of power needed is comparatively small. A picture approximately four or five feet can be projected with about the amount of energy required to pedal a bicycle up a moderately steep hill.

The apparatus is intended for untrained operators. It can be folded and is light enough to be carried readily from place to place for the purpose of illustrating lectures or for carrying on educational campaigns for the farmer in out-of-the-way parts of the country.

## Solidified Kerosene "Ice" New Form of Fuel

**SOLIDIFIED** kerosene, which can be carried in the pocket or transformed into liquid and burned in a lamp after mixing it with water, is a discovery of Dr. O. F. Reinhold, of Maplewood, N. J., for which remarkable utility is claimed.

The new form of fuel looks like petroleum jelly. It gives as much heat or light as liquid kerosene, and because of its compact, portable, solid form, it contains one third more heat units to the gallon. Unlike liquid kerosene, the new product requires neither wick nor mechanical contrivance to effect combustion. Kerosene cannot be ignited with a match, but you can set fire to Dr. Reinhold's product with a match, and it will burn like a stick of wood or "solidified alcohol."

The jelly burns steadily at an even heat until consumed, leaving an oily residue



Dr. O. F. Reinhold, the inventor, burning a piece of solidified kerosene

which the inventor claims can be used as a lubricant. When mixed with water, the jelly can still be ignited by a match, and the same oily residue appears.

Another advantage is the fact that the new substance eliminates the danger of kerosene explosions.



### Steeplejack Fells Tree from Top Downward

**W**HEN a tall eucalyptus tree at Rose Hill, Calif., began to split at the intersection of its two branches, threatening to fall on houses near by, a steeplejack felled the tree in 10-foot lengths, from the top downward.

The steeplejack first climbed to the top of one trunk, which he braced with three sets of guys. Then he began to cut the tree down from the top in sections, catching each section with a rope as it started to fall, and lowering it to the ground. The job took nearly a week.



Starting at the top, the tree was cut down in 10-foot lengths

### Harrow and Seeder in One Machine



Seeds are dropped from a lung hopper immediately above the harrows

**W**ITH a combination harrow and seeder now ready for use, the farmer can speed up the springtime work of planting large areas to grain and obtain an even "catch." The new machine consists of a boxlike girder or hopper which contains the seeds and to which the harrows are attached. Either one, two, or three harrow sections may be used with the

Because the seeds are released from a point only 11 inches above the ground, the makers of this machine claim that the usual unevenness of seeding due to the wind is entirely eliminated. In addition, the new method is said to reduce waste of seed to a minimum.

Dust from the Sahara Desert, blown thousands of miles by wind, is reported to have settled thickly on the decks of the Dutch steamer Yildum when 250 miles off the coast of the United States.

### Locomotive Sprinkler Lays Dust on Railway

**T**RAVELING over the dry desert for tourists since Superintendent W. H. Whalen of the Southern Pacific Railway devised an automatic track watering system that lays the dust beside the railroad right of way.

The sprinkler consists of a perforated pipe attached crosswise of the track beneath the tender of the locomotive and fed from the engine's water tank.



The sprinkler is a perforated pipe beneath the locomotive tender

### From Mule to Motor Bus on Street Car Tracks

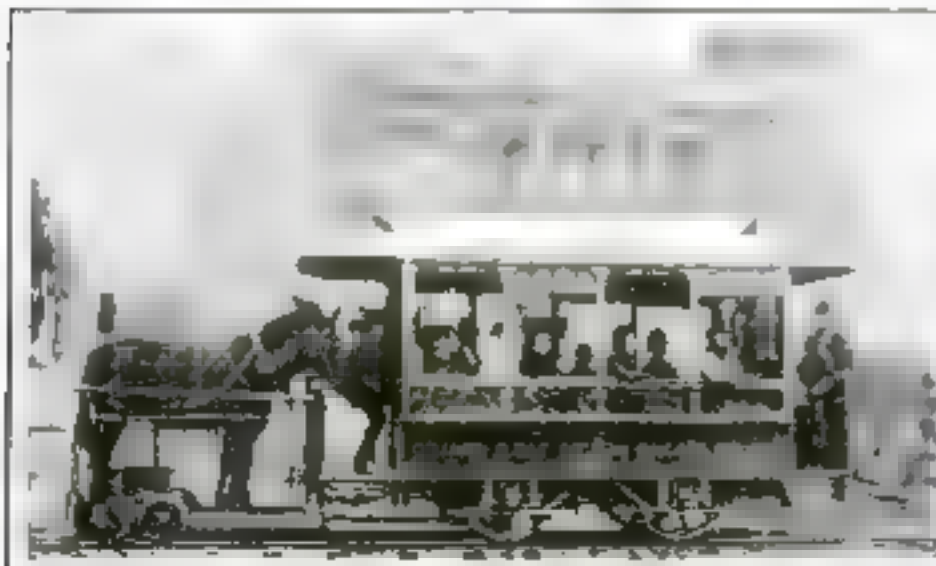
**B**ACK in 1892, the latest word in street car transportation was a private car for the mules that supplied the motive power.

After they had pulled the tiny car up an eight-mile hill near Ontario, Calif., the mules were unhitched and locked on a private platform, while the return trip was

made by gravity. But the electric trolley banished the mule, and now the gasoline bus is in many cities eliminating the trolley.

In 1922 the newest improvement is the operation of motor trucks on the car tracks in city streets. The first city to substitute the motor truck for the electric

trolley on car tracks is Manhattan, Kans. Light motor buses, with standard clumps and practically unchanged except for the wheels, are said to enable the company to give the same service for 15 cents a mile that cost them between 40 and 50 cents a mile when they were operating with electric trolleys.



**THE OLD WAY** After pulling the tiny street car up a hill, the mules made the down trip on wheels



**THE NEW WAY**—Light motor buses with flanged wheels instead of rubber tires, give cheap service in Manhattan, Kans.



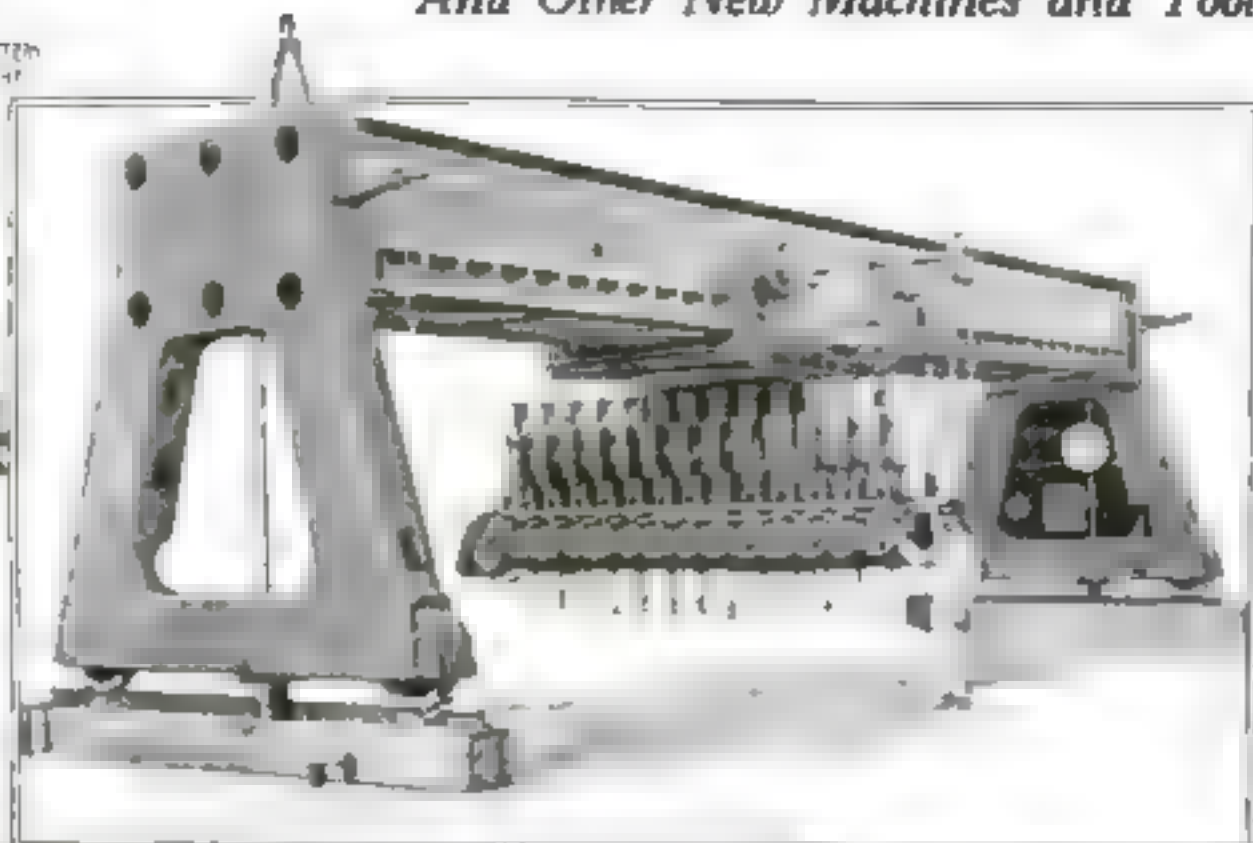
# A Monster Steel Plate Drill

*And Other New Machines and Tools*



MAJOR AND BATTERY  
COURT PHOTOGRAPH

This electric crane, of unusual length of beam, rests upon a truck propelled electrically, and if braced with a jack will lift very heavy loads.



Thirteen adjustable drill heads are mounted on the traveling carriage of this giant multiple drilling machine used for drilling, counterboring, and tapping huge steel plates. The spindles are eight inches apart and are driven by 50-horsepower motor mounted on the carriage.



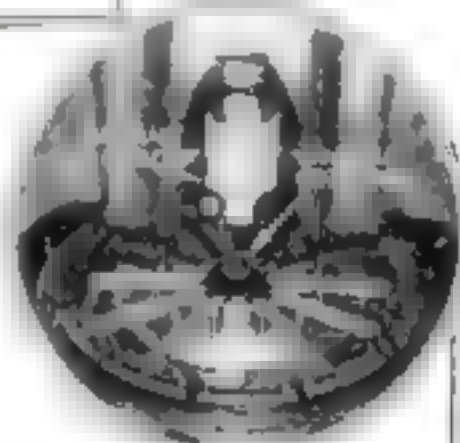
Current passing through the solenoid of this electric riveter, lifts one side of a can while the opposite side depresses the riveting plunger.



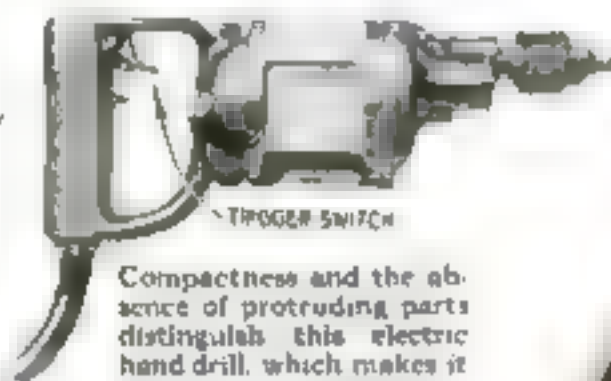
The above lathe, automatic in every operation, receives its work from a magazine and delivers the finished article.



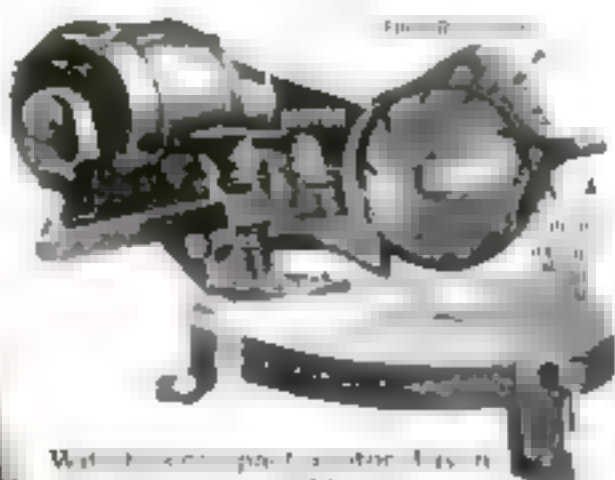
In this handy reamer and borer the cutter bearing spindle is mounted within a U-shaped frame having a clamping device at one end and a folding crank handle for turning the spindle by hand.



Radially mounted cutting tools of this gear cutting shaper remain stationary while the blank to be cut is pressed against them by a vertical plunger.



Compactness and the absence of protruding parts distinguish this electric hand drill, which makes it possible to drill holes in close corners and other difficult places. The drill is operated by a trigger switch.



With this compact circular saw, straight cutting or mitering can be done with speed.



The motor's friction wheel, adjusted toward or away from the center of the friction disk of this die filing machine, gives speeds varying from 300 to 700 revolutions a minute.



Every automobile repair shop equipped with a lathe should add this valve grinding attachment driven automatically by an electric motor.



Crankshafts, pistons, wristpins, valve stems, and other automobile parts may be ground accurately with this new type of universal grinding machine.



# Armstrong's "Radio Flivver"—Langmuir's Super-Tubes—Marconi's Wireless Beam

Jack Binns Explains Latest Radio Progress



Jack Binns, famous wireless operator, and author of important radio articles appearing exclusively in "Popular Science Monthly"

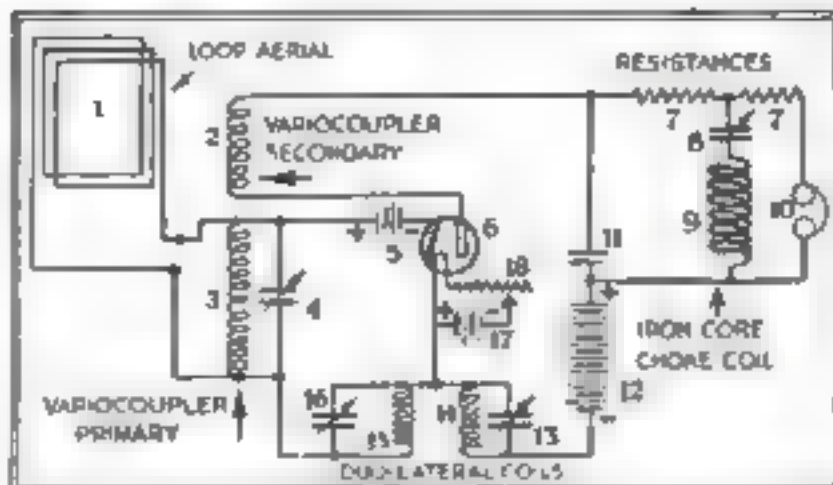
**S**O ASTOUNDING have been recent radio developments that I suggest a moment's pause in which to take stock of the actual accomplishments of this wonder period, and to analyze their bearing on the future.

Three major inventions recently announced are likely to have revolutionary effects upon communication, navigation, and industry in general. They are: the super-regenerative system; short wave directional communication by means of reflection; and the production of very high powered transmitting tubes.

## The Romance of Wireless

In view of the fact that there is a touch of romance in the possibility of casting one's voice clear across the Atlantic Ocean, I am going to outline the last of the three first.

At first glance it does not seem remarkable that such huge vacuum tubes have been developed, especially when it is taken into consideration that large tubes are in use every day at the radio-telephone broadcasting stations. It must be remembered, however, that when it comes to designing a



© Popular Science Publishing Co. 1922

**T**HE above diagram shows the already famous Armstrong super-regenerative system employing one vacuum tube only. In this circuit the constants are as follows:

1. Loop aerial, 12 turns on a 3-foot frame, wired spirally.
2. Secondary of the regulation variocoupler with twice the usual amount of turns.
3. Primary of variocoupler.
4. Variable condenser, .001 mfd.
5. The C battery; 4 volts maximum.
6. Vacuum tube.
7. Resistances, 12,000 ohms each.
8. Variable condenser, .001 mfd.
9. Iron core choke, 100 millihenries inductance.
10. Telephone.
11. Fixed condenser, .005 mfd.
12. B battery 30 volts maximum.
13. Variable condenser, .0005 mfd.
14. Duolateral coil, 1500 turns.
15. Duolateral coil, 1250 turns.
16. Variable condenser, .005 mfd.
17. Storage battery: 6 volts for UV 201, or 8 volts for UV 202.
18. Standard filament rheostat.

## Irving Langmuir—Creator of the Super-Tube

**A**LTHOUGH best known to the electrical industry as the inventor of the gas filled tungsten lamp, Dr. Irving Langmuir would, no doubt, call this achievement merely his first step in the development of the mighty 20-kilowatt vacuum tube—called the radiotron—a small cylinder of glass and metal, possessing power enough to transmit radio messages thousands of miles. Ten of these tubes—easily carried in one hand—are expected to replace huge generators weighing many tons.

Doctor Langmuir was born in Brooklyn, N. Y., and after graduation from Columbia University as a metallurgical engineer spent three years in Germany at the University of Göttingen, where he was fortunate to study under Professor Nernst, inventor of the Nernst lamp. On returning to America in 1906, Doctor Langmuir became instructor in chemistry at Stevens Institute of Technology, and in 1909 entered the Research Laboratory of the General Electric Company at Schenectady, N. Y., where all of his valuable researches have since been carried on.

Those who know him say that the spectacular successes of Doctor Langmuir are due primarily to his ever-present inquisitiveness. He has never been known to take a fact for granted. It was this quality that urged him on to the perfection of the super-radiotron after certain strange actions in the gas filled lamp had piqued his scientific curiosity.

The 20-kilowatt tube—his latest con-



Dr. Irving Langmuir, holding in his left hand the new 20-kilowatt tube, the largest ever made. The midget "peanut tube" is shown in his right hand.

tribution to radio science and designated by Marconi "the greatest development of the age"—contains a grid, a filament, and a plate. The filament is large and rugged and the plate, supplied with a direct current of 20,000 volts is a metallic cylinder 8 inches long and 1½ inches in diameter, sealed directly into the glass of the tube.

glass contained vacuum tube with a power output of 20 kilowatts, difficulties are encountered. The greatest of these has been to devise a suitable means of keeping the tubes cool during continuous operation. The ordinary method of cooling through the use of electric driven air fans does not suffice for the larger tubes.

After a long series of experiments, a 20-kilowatt tube has now been produced, with a water-cooled jacket of special design around its base. This tube is undoubtedly the key that will unlock the door to transatlantic wireless telephone communication. It was one of these tubes with which Dr. Irving Langmuir impressed Senator Guglielmo Marconi on the latter's recent visit to the General Electric plant at Schenectady.

It was my privilege some time ago to witness some of the experiments that were being made with a tube of this kind. This particular tube had a power output of only 12 kilowatts, but the extraordinary stunts performed with it give one a graphic idea of the wonder-working power of the great 20-kilowatt tube.

The tube I saw was supplying oscillating current at radio frequency to a "phantom antenna," which consisted of a bank of 12 incandescent lamps, each of one kilowatt. They were arranged in series with each other. These lamps burned with a brilliancy so terrific that it was impossible to look at them directly, and yet their dazzling brilliance came from the energy supplied by a single vacuum tube that in itself was no larger in over-all dimensions than any one of them.

## A Beam of Waves across the Sea

**C**AN you imagine a lighthouse throwing a beam clear across the Atlantic Ocean? It sounds pretty far fetched, doesn't it? Nevertheless, it is one of the myriad possibilities that have been opened up to us by the remarkable success achieved by Senator Guglielmo Marconi and his assistants in the development of electromagnetic waves of one meter in length transmitted in the form of a beam by means of reflectors.

With this system it is quite possible to shoot a beam across the Atlantic or Pacific, and to use the beam as a carrier wave for conversation, music, or telegraphic dots and dashes.

There is romance in the development of these reflected waves, and hound up in it is one of those cyclic recurrences that



dominate history. At the very outset of his career Marconi's first successful wireless telegraph set used reflected waves as the medium of communication between two points. This system was abandoned 23 years ago because it was considered impracticable. Now it comes back to exert a dominant influence.

There is another interesting phase in connection with this new development. Marconi, in conjunction with C. S. Franklin, H. J. Round, and several other young radio engineers, again began to experiment with reflected waves in Italy in 1916. For four years these experiments were carried on with no appreciable progress. Suddenly, in 1919, the human voice was shot over a distance of 20 miles on one of these directed beams. This was quickly followed by greater distances, until 100 miles was successfully negotiated with speech and music.

### Wireless History

I am in a position to tell for the first time just how the sudden advance in distance was obtained by means of reflected waves. The scene is laid in a Paris restaurant in January, 1919—that period of lackadaimical existence that followed immediately after the war. There are two chief characters. One of them is H. J. Round and the other Major E. H. Armstrong, of the United States Signal Corps. With the latter are a couple of friends, Harold Lewis and Harry Hauck, also radio experts. The dialogue runs as follows:

**ARMSTRONG:** Hello, Round! What are you doing here?

**ROUND:** Oh, I'm just having a rest after doing some special work. We've got something pretty good.

**ARMSTRONG:** I've got something pretty good too. Want to see it?

Armstrong then shows Round his super-heterodyne receiver—"the Rolis Royce of radio"—which he has just perfected and proceeds to explain it to him in detail.

**ROUND:** By Jove, old man, that would come in pretty handy for the work we're doing now! I'd like to use it.

The permission was readily given, and thus it was that the abrupt and phenomenal increases in distance obtained by Marconi and his associates in the short-wave directional experiments were possible through the young American's invention—the super-heterodyne.

## What Inventors Are Doing in Radio

### Smallest Vacuum Tube

A SPIDER web tuning coil, a miniature vacuum tube to be operated on a dry cell and a standard rheostat comprise the smallest vacuum tube receiving set in the world. When Sterling G. Sears was awarded a prize of a hundred dollars in New York City. Taps brought out to the inductance to a switch on the cover of the case provide for close tuning.



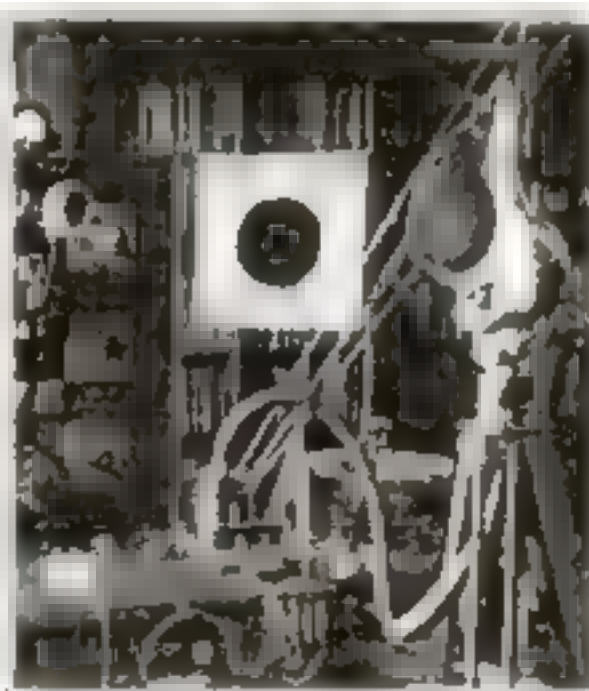
### Six Phones at Once

BY COMBINING the principles of the heterodyne and the super-heterodyne, a single phone receiver can be made to receive six different frequencies at once.

### Novel Loudspeaker

BY ADAPTING the familiar Briton shell of the musician to the rôle of a loudspeaker, Rev. Frederick L. Odenbach, director of the observatory at St. Ignace College, Cleveland, Ohio, has succeeded in reproducing jazz music with all its harmonics.

The loudspeaker was constructed by cutting off the small end of the shell and inserting one end of a rubber hose leading from the amplifying diaphragm of the receiving set.



### Radio Set in Cane

A RADIO receiving outfit incased in a hollow cane that incloses a fishpole arial, has been devised by C. H. Shipton, of Seattle, Wash., whose radio set in a razor case was described recently in POPULAR SCIENCE.

A single phone receiver is attached to the upper end of the cane stock. Tuning coils wound in multi-layer form are inclosed in the handle, with taps taken off for minute switches. Pinheads are used as switch points.



Such, in brief, is the inside history of the successful development of reflected wave radio. It might be well now to point out some of its immediate applications. One is the revolving radio lighthouse, and the other directional secret communication.

Experiments already conducted in conjunction with the British Lighthouse Commission at Inchkeith off the coast of Scotland, have been eminently successful, and the system is much more rapid in its

functioning than is the radio direction finder. In this system the reflector revolves in the same manner as a light reflector does in the ordinary type of lighthouse. It is connected with an automatic transmitter that sends out pre-arranged letters in the telegraphic code at predetermined intervals. With this system a ship caught in a fog is amply warned of the proximity of danger.

An effective extension of this system suggests itself for use in mid-ocean, and there is no doubt that its application will practically eliminate the possibility of collision at sea. Even if one of the ships is not equipped with the system, the other ship, getting the wave reflected back as soon as it strikes the metal side of the ship that is not equipped, will be warned of the nearness of the latter.

### Reflected Waves

Now that the development of receiving apparatus is progressing rapidly, especially from the point of view of ultra sensitivity, the reflected wave system will be invaluable in future transoceanic telephone communication. It will cut down the amount of power necessary to bridge the ocean with the human voice, because all of the energy carrying the voice will be going to the desired destination without being broadcast. It will also enable the use of a tremendous number of transoceanic stations at the same time, a condition that is not at all possible on the longer waves.

There is another important possibility. By means of the heterodyne principle, a steamship can be directed straight across the Atlantic or Pacific without varying an inch off its track, irrespective of weather conditions, by simply keeping in receptive touch with the reflected signals at all times. The beat note produced by the heterodyne could be attached to a loudspeaker, so that the helmsman would know immediately when he went off his course, because the moment he did so the signals would cease.

## Transatlantic Talks

AT THE outset I stated that it was an open secret that transatlantic tests of radiotelephony were about to be undertaken. In this connection it will interest

(Continued on page 107)



# Why I Believe in Government Radio

*Famous Advocate of a National Broadcasting System Says It Would Improve Wireless Programs*

By Charles E. Duffie

"**WE ARE** only playing with radio today. I may startle most people by my assertion, yet I firmly believe that in the practical application of the radiotelephone—especially for broadcasting news over wide areas—Europe has been in advance of the United States. Here, we have developed the receiving end to an almost fantastic degree, but the broadcasts received here have been largely in the nature of amusing vaudeville, and in the past few months there has been no lack of rumors from the public that this type of amusement is losing its appeal. Europeans, on the other hand, have had the broader vision of perceiving that the really magnificent future of radio lies in the spread of news and vital information."

These are the words of a man whose opinion is going to count mightily in the next few years. He is R. B. Howell, general manager of the successful Municipal Water Works and Gas Works of Omaha, Neb., the Republican nominee for Senator from Nebraska this fall, and probably the leading advocate of government broadcasting in this country. Himself a radio amateur and engineer of note, who has operated his own broadcasting station in Omaha, Mr. Howell, through an official investigation of the broadcasting situation here and abroad, made for the United States government, has had an unparalleled opportunity to acquire a definite picture of what radio may ultimately mean to the public.

A very common question lately, among users of home radio sets, has been, "What sort of broadcasts are we going to receive this fall?" The question reflects a prevalent discontent with the indiscriminate competitive jumble of phonograph music, uninteresting lectures, and dismissed advertising talks, which have, in part, made up many programs.

There are those who believe that the



R. B. Howell, radio expert and candidate for Senator from Nebraska

only possible solution of the situation lies in government broadcasting, and the most famous of all advocates of this belief has been Wil. Hays, formerly Postmaster General, and now so-called Dictator of the Movies. But while Mr. Hays gave to the idea, for a time, the prestige of his name and official position his jump into other fields has silenced him on this subject, leaving Mr. Howell indisputably the country's most capable and best informed booster of a national system of broadcasting by Federal and state agencies.

It was Mr. Hays who, a year ago, sent the Omaha utilities expert abroad on his mission of radio investigation. In the following interview given to me for *POPULAR SCIENCE MONTHLY*, Mr. Howell tells for the first time to the American public as a whole the results of his investigation, and the reasons that make him an ardent advocate of government broadcasting.

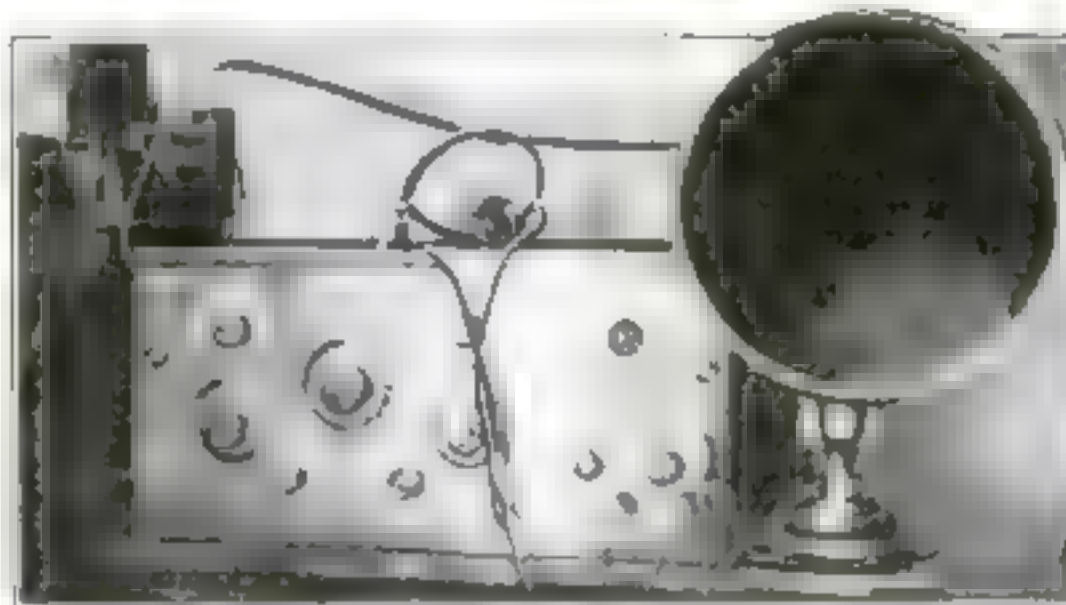
"In Europe—especially in Germany—I found that the control both of sending and receiving stations was entirely

regulated by the government," said Mr. Howell. "The German plan is to broadcast news of different kinds on different wave lengths. The German Post Office plans to sell, adjust, and maintain receivers that will be set to respond to but one wave length. Thus the subscriber, if he wishes to hear financial news, may hear that kind of news only—and he will pay a certain sum for the service, or he may have several receivers and get all the broadcasts."

"In this country, of course, it is impractical to try to exercise control of receiving sets. Such control is not in harmony with our ideas of popular government; and if it were, there are now so many sets in operation that an attempt to restrict them would cause an uproar."

"But we must follow our ideas of free and unrestricted receiving to the logical conclusion, and this, to my mind means broadcasting by the government itself, which is the only

## Popular Science Monthly's Great Radio Set



Leslie S. Greenblade, of Hamilton, Ont., and above, the attractive and efficient receiving set that he built from the Popular Science Monthly blueprint. With this set and an average aerial he has heard clearly most of the broadcasting stations in the Eastern United States.

**TYPICAL** of scores of letters from readers telling of unusual success in receiving broadcasts with radio sets made from the *POPULAR SCIENCE MONTHLY* two-stage receiving set blueprint (see page 91 in Home Workshop Section) is the following sent to us by Leslie S. Greenblade, 475½ King St., Hamilton, Ont., Canada:

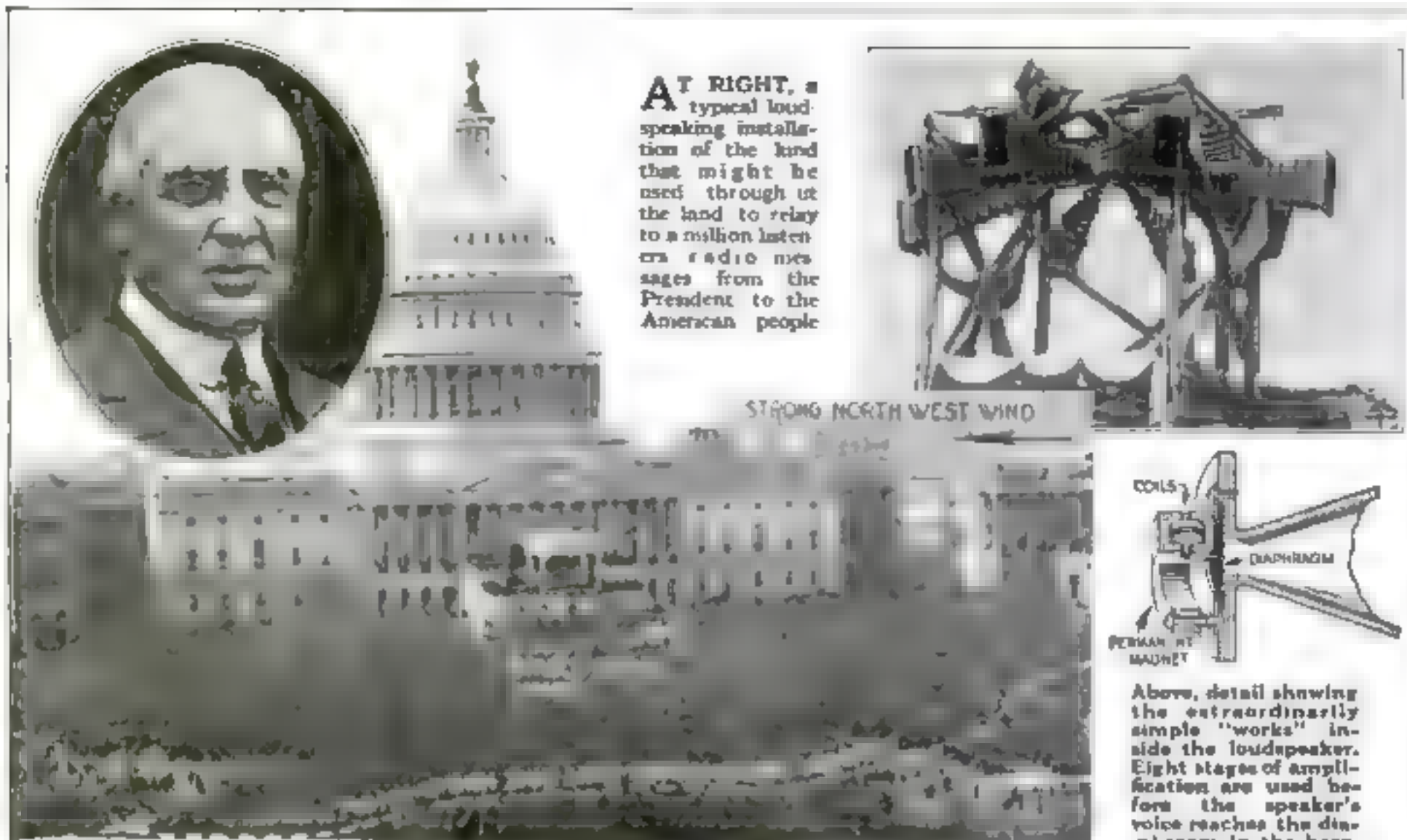
"I have had wonderful results with a receiving set made from your blueprint showing a two-stage amplifier. I have heard clearly music and voices from Anacostia (NOP), 335 miles; Chicago (KYW), 380 miles; Madison (WHA), 475 miles; Newark (WJZ), 332 miles; Schenectady (WGY), 285 miles; Parkersburg (3ZO), 215 miles; Pittsburgh (KDKA), 215 miles; Detroit (WWJ), 190 miles, and from many others."

"My aerial consists of a single wire No. 12 stranded, 150 feet long, 90 feet high at the lead-in end, and 65 feet high at the far end. My ground is a No. 4 wire leading down the outside wall to a water pipe in the basement."

"The large size specified for the panel is a real advantage because all the B batteries can be enclosed in the cabinet and still leave room for two stages of radio frequency amplification if desired."

"Every one who has seen or heard the set has wanted to know where the blueprint came from."





**T**HE enormous power of loudspeakers now available is illustrated by the above photo of the famous scene when President Harding delivered his inaugural address. Investigation of audibility made it possible to plot the exact range of the amplifiers, as indicated in the picture.

It is remarkable that while the President's words were carried distinctly to listeners on the outskirts of the crowd, they were not made to sound too loud to

people directly under the amplifiers. The reproduction of his voice by the loudspeaker was so perfect that those in the first rows could not tell where the natural voice left off and where the amplified voice began. Walking away in a straight line from the platform, one could have detected no change in tone and but small variation in the volume.

Under a completely national system of government radio broadcasting such as that proposed by Mr. Howell in the accompanying

article, it has been suggested that important public addresses and debates on vital political problems, like the bonus, tariff, and prohibition, would be broadcasted over the whole country from Federal transmitting stations, and received not only by home radio users on their own sets, but also by huge crowds like the above, gathered around loudspeaking installations in the parks and other public meeting places of big cities.

logical agency for this work. In the first place, the government has the greatest vested rights in radio. Furthermore, during the world war, the government practically financed the experiments that have led to today's perfection in radio apparatus. Private enterprises control the radio patents, but the government controls the ether!

### Necessity of Close Control

"In the two conferences held by the nations of the world to allocate wave lengths, the United States asked for but \$5. These, for the use of a nation of 100,000,000 people mean that if radio is to be a great public utility (which it will be if properly handled), sending apparatus must be closely controlled.

"The erection of transmitting stations would not exceed a cost of two cents a square mile of territory served.

"Such a radio broadcasting service must include, in addition to news bulletins, market and weather reports, other features, such as short stories, discussion of popular current topics, and music and other entertainment of the highest type.

"As an instance of what might be accomplished, I believe that a telegraphophone can be used to record Metropolitan grand opera in New York or elsewhere, the reels of this wire then being sent in turn to the various transmitting stations, all at the cost of one recording. Necessarily, such a service would require a central staff of highly competent experts to prepare and edit programs.

"Only the government, in my opinion, can operate such a national service without hopeless conflict between stations, and the rational operation of a government-owned radio newspaper would bring wonderful results."

Mr. Howell's interest in radio began when, in 1908, he entered the fight to allow Omaha to buy the then privately owned water plant. Being powerfully opposed in his course by one of the newspapers, he was eager for some means of securing publicity, other than the usual sources at his command. Remembering that he had read of the slight success of the radio-phone in the navy, he wrote to Admiral Kountze, an old classmate, and inquired as to the practicability of the radio transmitter. The reply was, in effect, "Great future, not practical now, as it is little more than a scientific toy."

### Hungary's "Telephone Newspaper"

He never lost interest in radio, however, and on March 4, 1921, while lunching with Postmaster General Hays, suggested the publication of a radio newspaper by the government, touching on the success of the so-called "telephone newspaper" of Budapest, where such a paper had been "published" for more than 25 years. Mr. Hays immediately expressed great interest. In less than six weeks, the government began to broadcast weather and market reports from the air mail stations, by radiotelegraphy. The Radio Service Commission was soon after appointed, with Mr. Howell as chairman, and he sailed for

Europe September 8, 1921, to investigate radio- and wire-telephone broadcasting.

Recounting in his talk with me some of the things he learned about European broadcasting, Mr. Howell described a novel experiment in Holland. "On the fifth of January, 1921," he said, "the Amsterdam Bourse began the broadcasting of Bourse news and quotations to some 200 banking and brokerage houses throughout Holland. It was a cooperative enterprise, each banking house contributing about eight dollars a month for the service, which includes the supplying, installation, and maintenance of a receiving station.

### How Europe Does It

"An interesting form of receiving station developed by the Germans for their post office broadcasting service includes an electric bell, calling subscribers to the phone when special news outside of the regular schedule is about to be transmitted.

"The Hungarians have done little with the radiotelephone, but in Budapest there is a highly interesting development in the form of a telephone newspaper that is now in its twenty-eighth year of publication. This enterprise consists of 42 party lines, serving some 6000 subscribers. Each station has two or more receivers, but no transmitting apparatus. It is the stenter at the central office who does all the talking over this system of wires, and is heard by all subscribers at one and the same time. The transmission of news begins at nine o'clock in the morning and is carried on throughout the day in accord with a fixed



schedule, so that any one interested in a particular class of information knows just when to listen in. In the afternoon a short story is offered, or a chapter from a continued story. At four-thirty the concert of the Imperial Band begins, transmitters being placed about the band stand. While in the offices of this unique newspaper, about five o'clock one afternoon, I heard the stentor announcing the personnel of the artists who were to sing at the Budapest Opera House that evening, and later, at the home of the manager of this newspaper, I enjoyed the

**A** NATION-WIDE government broadcasting service would become, in its way, as important to the public welfare as is the Postal Service today.

privilege of listening to Wagner's 'Die Walküre,' in common with other subscribers throughout the city.

"All that has been done of this character with the wire telephone can be done with the wireless telephones. While Will Hays was Postmaster General, he conceived a concrete plan for the installation of radio broadcasting stations throughout the coun-

try, say about 400 miles apart, so that weather and market reports, news bulletins, and, incidentally, amusement, might be afforded to our widely scattered population in their own homes. Under this plan, each listener would provide his own apparatus, while the government would bear the expense of the installation, maintenance, and news service of the transmitting stations.

"But to be successful, the service would have to be dependable. Stations must be powerful enough to 'get through' under all

*(Continued on page 107.)*

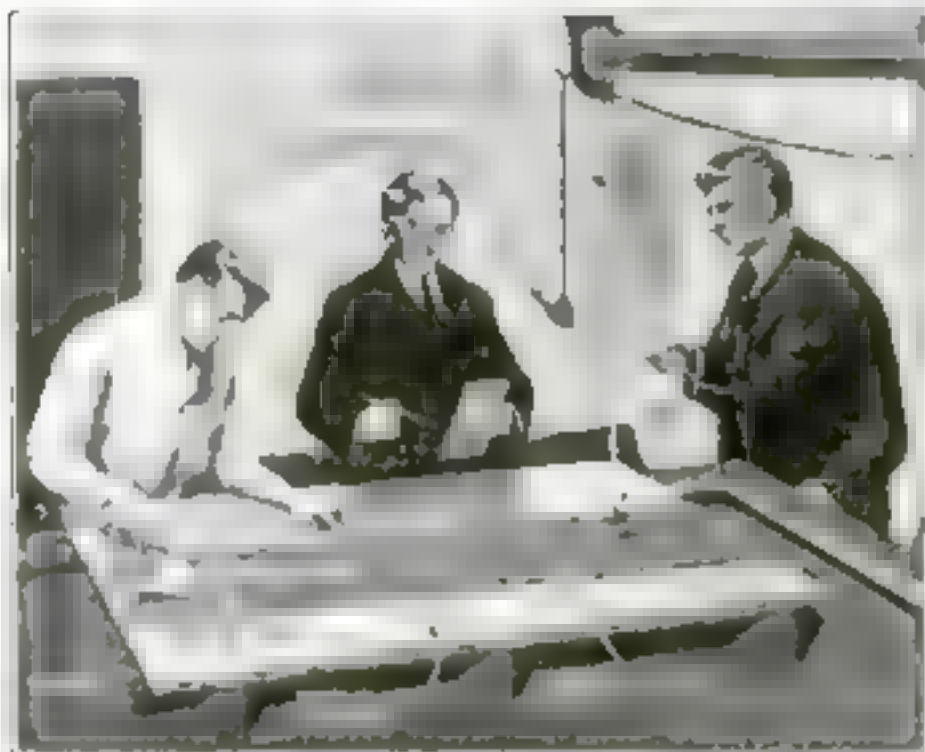
## Play Billiards with Magnetized Cue

**S**LACK in the cloth covering on billiard tables will reduce the length of the estimated roll of the ball from 5 to 10 per cent, according to recent tests conducted by the Bureau of Standards. But the direction of the nap makes little difference.

The test method consisted in measuring the distance traveled by a standard billiard ball after rolling down an inclined plane onto samples of the cloth stretched over a steel surfaced plate. The tension was varied by weights attached to the ends of the material.

Additions: tests were also made to ascertain whether different kinds of cloth had any effect in retarding the spin of balls. A two-inch steel ball was supported by an electromagnet on the lower end of a vertical steel shaft. With the ball held just above the surface of the cloth, the shaft was brought up to a speed of 1900 revolu-

tions a minute. Then the magnetism was destroyed and the spinning ball dropped on the sample of billiard cloth stretched tightly over the steel surface plate. By noting with a stop watch the time required to bring the spinning ball to rest, it was found that the difference of one cloth over another was too slight to be noticeable.



The ball at the left is testing cloth for tension. At the right the steel ball measures resistance to spinning.

## Big Wash Bowl Shakes Mud from Cars

**H**UGE wash bowls, around which automobiles are run to remove the dirt from the under body, have been installed near a St. Paul, Minn., garage. The bowls

are 75 feet in diameter and accommodate six cars at a time.

The wash bowls are shallow concrete basins sloping gradually from the outer edge to the center, with water varying from a few inches to 34 inches in depth.

Separate ramps lead to the basin for incoming and outgoing cars. As the car goes down the ramp, an attendant clamps a waterproof cover over the radiator. On the bottom of the basin concrete strips one inch high radiate from the center and as the cars pass over them the vibrations shake the loosened mud and grease from the metal parts.



A few turns around the bowl remove hard-caked mud and grease. Figures on the tags indicate depth of water.

## Compressed Air Grease Gun Measures Lubricant

**A** GREASE machine operated by compressed air and adjusted by a valve to dispense exactly one half pound of lubricant at a time is now being used by garages to insure accurate measurement of the grease used in filling transmissions, differentials, and timing gears.

The lubricant is poured into the top of a 12-gallon container that is connected with an air chamber. Compressed air is let into the chamber until a pressure of 75 pounds is obtained. From the lubricant holder a flexible hose leads to the grease gun.

To fill a grease cup the snout of the gun is inserted into the opening of the cup and a valve on the gun given one complete turn. The compressed air forces one half pound



By turning the valve a supply of grease passes into the cup.

of the grease out of the container. Another turn of the valve will force another half pound, and so on. A neutral point on the valve permits the operator to stop the grease flow at any point.

By means of a pair of trucks on the base, the machine can be wheeled with ease.

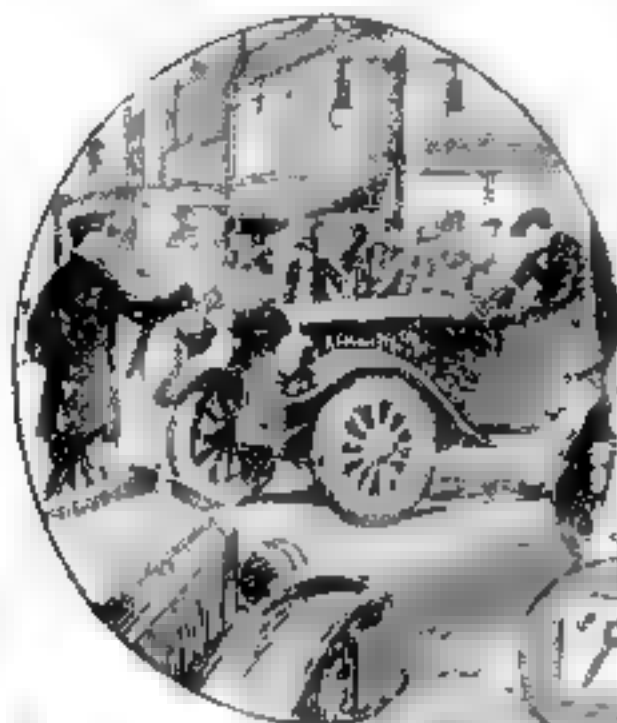
## Horses Shod with Copper

**R**ECENTLY all the horses on a California ranch were reshod with copper shoes. It was believed that the steel shoes previously worn had generated sparks that set fire to the dried grass by striking pieces of loose flint.



# STALLED!

## How to Find the Trouble Quickly when Your Engine Dies



IS THERE GASOLINE IN THE CARBURETOR?

5 QUESTIONS TO ASK INSTANTLY WHEN THE ENGINE BALKS

IS THE THROTTLE NEARLY CLOSED?

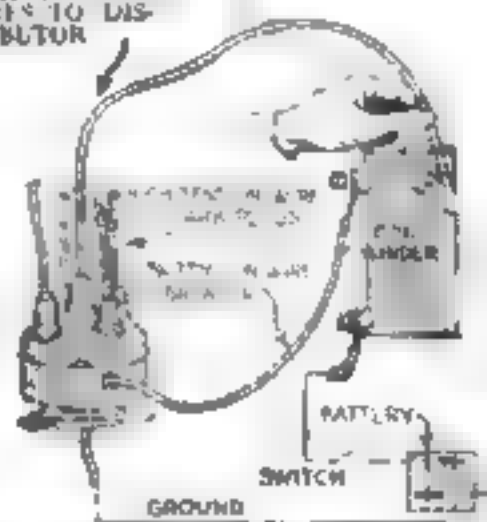
IS THERE GASOLINE IN THE TANK?

IS THE CHOKE PULLED OUT?

HIGH TENSION WIRES TO DISTRIBUTOR



THEN FLOOD THE CARBURETOR.



LOOK FOR LOOSE WIRES



GASOLINE-FILLED OIL-CAN TO PRIME ENGINE



IS SPARK ADVANCE MECHANISM DISCONNECTED?



THE THROTTLE MAY STICK OPEN

This may be caused by looseness of the setscrew shown above

for a half dozen revolutions, and then died. "What's the matter?" asked the stalled motorist.

"Kerosene," I replied. "The last place you bought gasoline must have filled you up with kerosene instead."

"What I'd like to know," the man interjected, "is how I managed to get this far, if the trouble was caused by kerosene."

"That's easy," I returned. "Your engine was warm when you bought that fuel. But when you got out here you stopped for a couple of hours, and the engine cooled off. A warm engine will run on kerosene, but a cool one won't."

"Well, another thing I want to know," he said, "is how you discovered inside of two minutes what I hadn't found out in half an hour."

"A logical system plus observation," I replied.

And the fact is that detecting the cause of a dead engine is as interesting as taking part in a detective story, if

turn on the ignition switch not only part way, but all the way.

The next thing to determine is whether there is *actually* gasoline in the tank. What you think does not matter. Tanks and pipes spring leaks, you know.

Next, be sure that the choke is pulled out. A great many cars cannot be started otherwise. Then see that the throttle is open only a little, perhaps one eighth.

**2. FLOOD** the carburetor by lifting the needle off of its seat. If after a few moments gasoline streams out, it shows that lack of fuel at the carburetor is not the cause of the stoppage. If the carburetor does not flood, and yet there is gasoline in the tank, it shows the pipe is stopped up, or that the vacuum system is not working properly.

### System Eliminates Trouble Spots

**3. LOOK** for loose wires. A few moments should be sufficient to detect any trouble here, and remedy it, if found. If not, we know by now that the trouble is not in the wires, nor in the fuel system, unless, possibly, it is within the carburetor itself.

**4. OUR** next step will show whether the balkiness is caused by the ignition or by some derangement of the carburetor. We'll prime the engine by introducing about a teaspoonful of liquid gasoline into each cylinder. Then we'll turn on the switch and crank it. If we obtain any explosions at all, it is reasonably safe

4. If the engine still refuses to go, prime it with gasoline, using an oilcan or squeezing it from a saturated rag. About a teaspoonful in each cylinder is enough.

5. See that the spark advance mechanism has not allowed the distributor to slip out of time. The loss of a cotter pin may have permitted it to slip into the position shown below by the solid line.

By  
Harold  
F.  
Blanchard

**W**HEN your engine goes dead, how long does it take you to locate the seat of the trouble and get under way again? I am willing to wager you have often spent anywhere from 10 to 20 minutes in unsystematic fidgets over the situation—and perhaps have even resorted to the expense of calling a trouble car from the garage.

Yet a simple common-sense system, coupled with real knowledge of your car, is all that is necessary to make the investigation of a dead engine an amusing rather than expensive experience, and, incidentally, to start the engine again in a minimum of time.

A recent experience of my own will make this clear.

I pulled up on a country road, the other day, to help a stalled and obviously puzzled motorist. He couldn't start his engine, yet he couldn't find a single thing wrong with it.

### When an Expert's on the Trail

As I walked over to his car, I noticed that the gasoline gage read half full. I turned on the switch, opened the throttle just a trifle, pulled out the choke and stepped on the starter. Nothing happened. I then flooded the carburetor. Some of the fuel spilled on my fingers, and it did not feel exactly like gasoline. I sniffed it, then went to my own car and pulled out a squirt can full of gasoline. I primed the balky engine and she responded splendidly

These illustrations, numbered to correspond with the numbered paragraphs in the article, show the simple clues that are easy to follow in playing detective over a dead engine.

1. As soon as the engine balks, make all five tests illustrated.

2. Flood the carburetor by pulling or pushing on the needle valve.

3. Look sharply for loose ignition wires and defective insulation. A binding nut may have fallen off, as indicated.

you follow a systematic procedure and use your eyes and head as you go.

**1. ANSWER** the following questions:

Is the switch on?

Is there gasoline in the tank?

Is the choke pulled out?

Is the throttle nearly closed?

Is there gasoline in the carburetor?

These are obvious questions, but it is folly to proceed until they have all been answered.

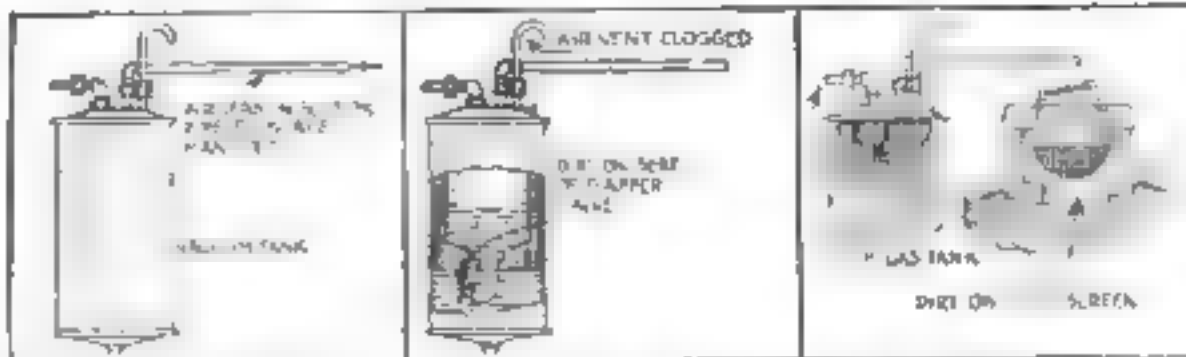
Difficulty in starting an engine, especially at night, is often due to failure to



## Vacuum Tank Troubles

**V**ACUUM tank troubles that may stall the engine are made clear in diagram at the right. They are easily cured but still more easily avoided. A gasoline filter will prevent two of them, as well as insure against much carburetor trouble, while a leaky suction pipe is cured by keeping its connections tight.

If the air vent closes, fuel cannot flow from the lower part of the vacuum tank to the carburetor. If dirt lodges on the flapper valve, fuel that flows to lower tank when suction is shut off will be drawn back into the upper tank when suction is on again. There is a small filter screen where the gas-



oline pipe from the main tank enters the vacuum tank. Keep it clean. Leaky floats are almost unheard of, however, a leaky

float will cause raw gasoline to flow into a take manifold and the engine will exhibit symptoms of a very rich mixture.

to assume that the trouble is in the carburetor. But if no explosions are noted, the trouble must be in the ignition.

**5.** DON'T forget that the failure of the functioning of the simplest car parts occasionally causes engine stoppage. The distributor may become turned around, or

**6.** THE throttle may stick open, or the switch may not close the circuit, or the ignition drive may fall or slip out of time. Rare difficulties such as these should be kept in mind, while a search is made for the more common troubles.

We'll assume, first, that priming the engine brings forth no explosions. Careful observation shows that outside of the causes of engine stoppage already mentioned, the ignition system usually is the seat of the trouble.

**7.** THE first place to look for ignition trouble is not at the source—the battery—but at the breaker points. If the points are not smooth, they should be filed, or removed and ground on an emery wheel, until they are smooth and true. Then they should be replaced and adjusted carefully. The correct gap differs according to the ignition system, but it is somewhere between the thickness of a newspaper and 1/64 inch. Before adjusting the points, be careful to turn the engine over, so that the breaker arm is resting directly on the top of its cam.

**8.** IF THE engine still refuses to run, our next job is to determine whether

current is flowing through the low tension circuit.

Turn the engine over until the points are separated, turn the switch on, and

**9.** ON THE other hand, if the spark here is feeble, or is not evident, it is probable there is something wrong with the low tension circuit. The battery must be considered O. K. unless it is too weak to do more than make the lights glow faintly. Some of the wire connections may be loose or dirty, or the insulation on some wire may have worn away, allowing a short circuit. Or a grounded strand of wire may be causing the trouble.

You see, the science of deduction plays a most important part in curing a balky engine. By carefully examining our various clues, we are led to concentrate on the ignition system, and it is logical to study the low-tension or low-voltage half of the system exhaustively before considering the high-tension system.

No possibility can be overlooked. The low-tension wires must not be short circuited, the switch must function properly, the connections must be clean and tight, and the condenser must be sound. If the condenser is punctured, it is possible that the current will leak through it, rather than flow through the breaker points when they are closed. However, if the condenser fails, this fact should also be indicated by excessive pitting of the breaker points.

**10.** IF NO fault is found in the low-tension circuit, proceed to the high tension. There are very few derangements of the latter which will cause missing. Wet wires, short circuit in the spark gap, leakage of current from the main wire running from coil to distributor.

(Continued on page 72)



## YOUR CAR

**Y**OUR car costs you nearly twice as much to run as it should. If you understood it and you took care of it, if you drove it right, and yourself made the simple repairs and adjustments that you now pay for at the garage, you should get 40,000 miles of service out of it, at a total cost in operation and depreciation of only \$1674.

Now it is estimated that the average motorist who drives a \$1000 car gets about 15 miles to a gallon, 10,000 miles on tires, and after running about 25,000 miles finds the car's value has depreciated to \$300. During this period repairs cost \$150, careless driving \$50, and \$50 is spent for wash ups of one sort or another. Tires cost \$160 and gasoline about \$400, making the total cost of running the car \$1510 for 20,000 miles—against a possible \$1674 for 40,000 miles!

The unseen demons of waste pictured on POPULAR SCIENCE MONTHLY'S cover this month, are responsible for the excessive cost of your car. Simple attention to engine, tires, lubrication, and carburetor adjustment coupled with careful driving—and repairs at home instead of at the garage—should make the total cost of running this average car including depreciation less than 4 1/4 cents a mile instead of over 7 1/4 cents which its owner generally pays.

The article on these pages is one of a unique series that will help the motorist detect the invisible demons of waste which keep piling up his car expense. Read these articles, learn to know your car, and henceforward save nearly half what your car now costs.

then short circuit the points with a small piece of wire. If a crackling spark shows that good current is flowing, it is more than probable that the low tension circuit will be found to be all right.

derangements of the latter which will cause missing. Wet wires, short circuit in the spark gap, leakage of current from the main wire running from coil to distributor.

A large percentage of ignition trouble is found at the breaker points. They must be smooth and in good adjustment. A single strand of loose wire touching the metal base may be the unsuspected source of difficulty.



IF THE POINTS ARE NOT SMOOTH, USE A FILE

SHORT CIRCUIT WITH A SMALL PIECE OF WIRE

A LOOSE STRAND OF WIRE MAY BECOME GROUNDED

IF THESE WIRES BECOME WET, THE ENGINE WILL NOT RUN

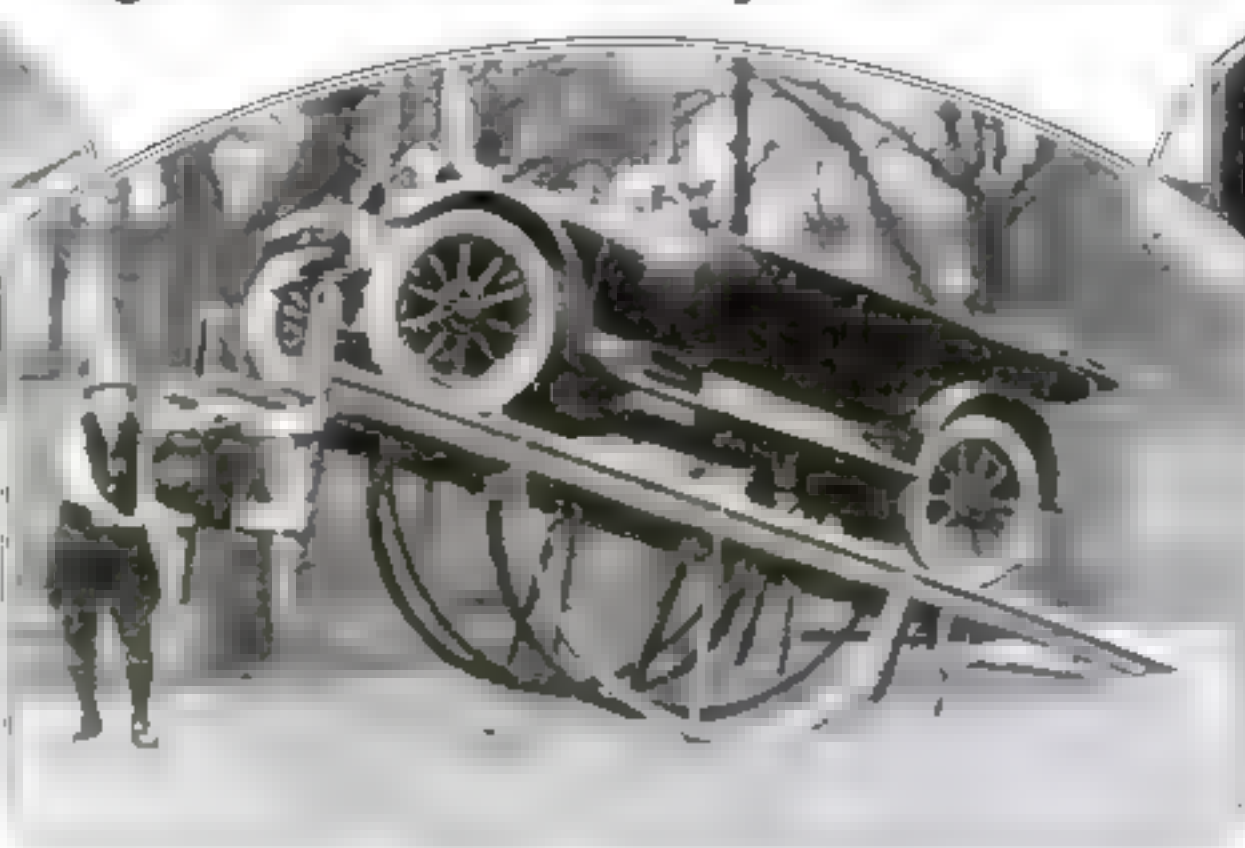


# Portable Track Simplifies Automobile Repair

## Eight Other Inventions for Car Owners



One of this L-shaped spark plug tester is slipped under the terminal and while the lower end is held against the ground, the plug is pressed against the base of the plug.



During long rides this car is protected against wind and rain by a device which can be raised or lowered at will.

To facilitate repairs under the car, this track on rockers is useful. With the track lowered at one end, the car is drawn up the incline by a hand winch. The track is then braced horizontally.

**AS** A special service to readers, the Editor will be glad to supply the names and addresses of manufacturers of devices mentioned in this issue.



Equipped with a flexible steel hose reaching to the opening of the gasoline tank, this new type of can makes it possible to fill the tank without a funnel and without danger of spilling a drop.



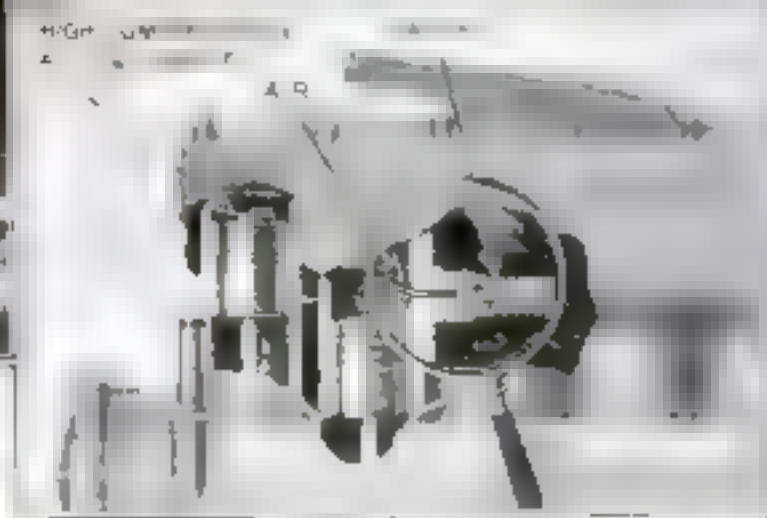
By the aid of this device even a physically weak person can quickly lift the heaviest spare wheel to its place in the rear of the car and fasten it securely with bolts to the carrier plate.



With this alternating current voltmeter, almost instant adjustments may be made with the hand magnet, whether the car is standing or running, and the correct length of the magnet may then be made.



Hinged to the running board, this device serves the usual purpose of a step plate and a suitcase holder. In the car, the plate has cut eyes through which straps may be passed to hold the suitcase firmly, as above. The device is attached with screws.



A spring-closed valve that is uncovered only when the piston reaches the bottom of its stroke. The air admitted gives higher compression when running with throttle partly opened.




When the door of the garage is fully opened, the hook of this gadget will slip into a notch and make it impossible for the door to swing shut from wind pressure. The catch is easily released for closing the garage door by lifting it with one finger.




# Keeping Your Car at 100 Per Cent Efficiency


**DANGER** wasted money, lost time, and mispent energy all menace the motorist who neglects certain small but necessary adjustments and repairs to his car. A national survey on automobile repairs and maintenance expenses is pictured on this page, together with the national plan of keeping your car at 100 per cent efficiency.




**IT** is a wise policy to examine the tires from time to time. Holes, dents, or the foreign matter may drop into the tread, or the air may be detected as it escapes. Place a tire on the ground as shown at the left, and measuring it with the tape, make a careful inspection, noting the tire's foot at a time.




**BEFORE** repairs to door locks or top irons can be made or dents taken out of the metal body of the car, the upholstery must be carefully removed. The picture above shows how easily it can be done if proper care is exercised.



**LEAKAGE** of grease through the rear axle flange is quickly stopped by removing the nuts of the hub, pulling out the hub and axle shaft and fitting a gasket of heavy wrapping paper over it.



**TO ADJUST** the brake points, pull the brake lever up and rotate the brake shoe forward or backward until the point of contact is opening is reached, then turn the spindle to the right position.

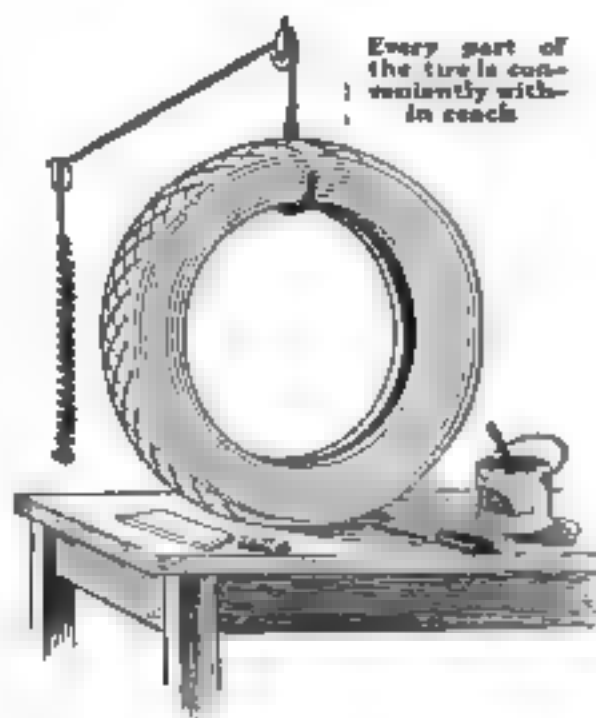


**WHEN** the brakes are broken down, they should be tightened and set, but should not interfere with the movement of the wheel when off Jack or the car is raised and then by hand. They should spin freely. If the front wheel is found to be stiff, it should be adjusted and should be a good and the brakes no longer show a tendency to bind.

**THE** adjusting of the brake mechanism should be made if it is usually impossible to obtain sufficient light. A correct light lamp is indispensable.



## Holding Tires in Position for Repairs



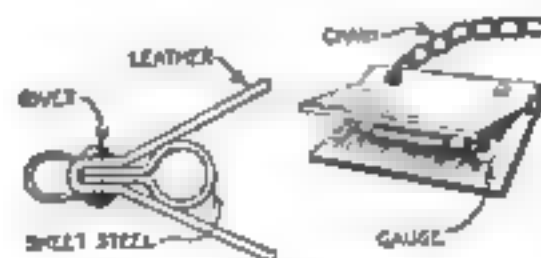
IN THE accompanying illustration a simple method is suggested for holding an automobile tire in an upright position on the bench while undergoing repairs.

Above the bench a hook is screwed in the ceiling for supporting a pulley. The hook should be so placed that when the tire is suspended by a rope passed over the pulley, it will be in the desired position. The rope, passing over the suspension pulley, is then passed over another pulley fastened to the wall and tied to one end of a coiled spring, the other end of which is attached to a hook in the wall.

The weight of the tire will be enough to pull down the suspension hook until the tire rests on the bench. The tension of the spring should be strong enough to counterbalance the weight of the tire. When the tire is removed, the spring will draw the hook out of the way.—T. P. W.

## Protecting the Tire Gage from Loss and Damage

SHOWN below is an attachment used by a service station to avoid the loss of and damage to the tire gage used by the customers of the place. It consists of a piece of heavy leather doubled over and riveted with a steel clip fastener about the

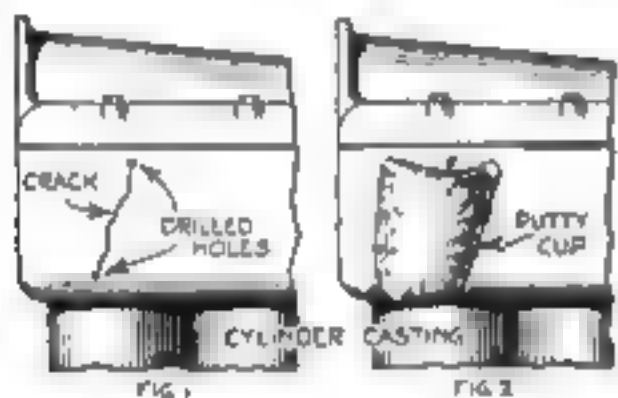


Leather flap prevents damage when gage is dropped

tire gage and a long section of chain attaching it to the portable air compressor.

To use the tire gage the flexible leather is pushed back and the tire gage can be inserted between the wheel spokes and over the valve stem.—G. A. LUERS.

## "Rusting Shut" a Small Crack

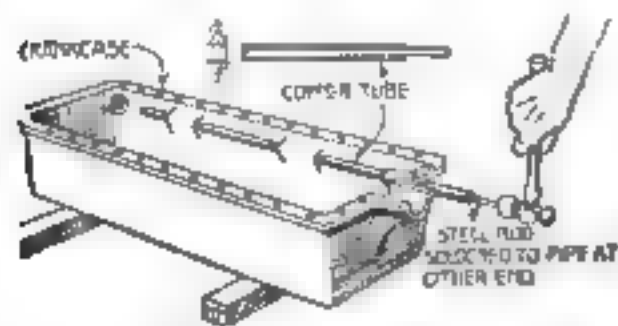


IN THE midst of the threshing season a neighboring farmer found that a small crack in the cylinder casting of his tractor allowed the water to leak from the cooling system. He filed the edges of the crack until they were bright, drilled two holes in the jacket, one at each end of the crack, drove plugs into them, and filed the plugs off smooth.

Then he built a cup of putty around the crack and poured into it a solution of  $\frac{1}{4}$  lb. of sal ammoniac dissolved in 1 qt. of water. When the crack was completely immersed, he let the solution stand for a time until the opening had "rusted" shut. Then he washed the solution thoroughly out of the cooling system.—Ed. HENRY.

## How to Insert New Oil Pipe in a Crankcase

WHEN inserting a new oil pipe in a crankcase, the easiest and quickest way to drive in the pipe is to fit a steel rod inside of it, soldering the end of the rod to



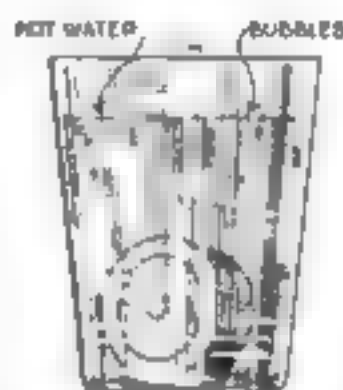
A steel rod stiffens the pipe

the pipe. By hammering on the rod, the pipe may quickly be driven into place. Then by applying a little heat, the solder is melted so that the rod can be withdrawn.—L. S. D.

## To Find a Leak in a Metal Float

OCCASIONALLY the metal float in the carburetor becomes leaky and causes the carburetor to flood. If the float is shaken, the gasoline can be heard splashing on the inside, but it is often difficult to find the leak.

If the float is placed in a glass of very hot water, small bubbles will soon come from the leak. When the gasoline is heated, some of it evaporates and sets up a pressure within the float that causes the bubbles to escape. The opening should be carefully marked



so that it can be found easily when it is to be repaired.

Next, the float should be punctured with some sharp instrument and all the gasoline drained. To make sure of getting out all the gasoline, it should be dried for some time in a warm oven or in the sun.

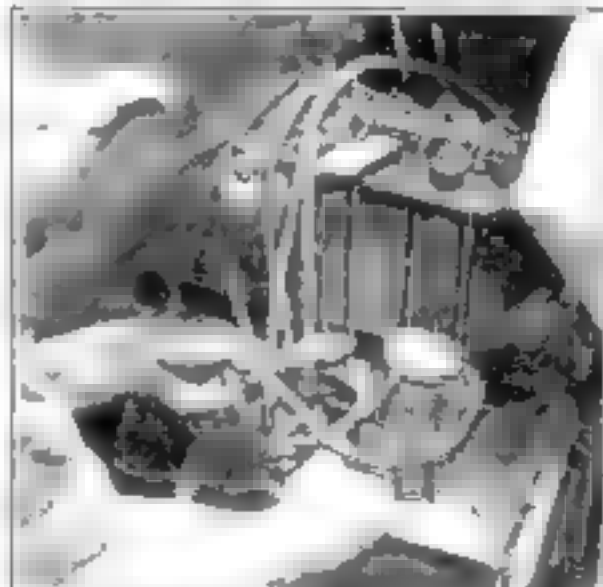
The next step is to prevent further leakage by soldering the puncture.

Only a small amount of solder should be used, as a little difference in the weight of the float will be sure to cause trouble.—E. S. GIBBS.

GASOLINE will remove road tar when soft, and either lard or oleomargarine will soften the tar after it has begun to harden. To prevent damaging the varnish, remove tar as promptly as possible.

## Adjusting Automobile Valves

IN ADJUSTING valves on an overhead valve motor, it is a good plan to determine the clearance by inserting a strip of



A piece of cardboard is inserted under rocker arm

thin cardboard under the rocker arm. Then adjust the valve stem until all excess clearance is taken up.—H. F. BLANCHARD.

## How to Find the Trouble

(Continued from page 69)

and leakage of current, due to a visible or invisible crack in the distributor, are the main troubles.

Water on the spark plugs or distributor may provide a temporary short circuit for the high-tension current, and thus prevent the starting of the engine. The best remedy for wet wires is to place them in a warm spot, but not so hot as to injure the insulation.

An invisible crack in the distributor may prevent the running of the engine, since the high-tension current may leak through this crack rather than through the various wires to the spark plugs. Sometimes this leakage will only occur when the engine is extremely warm, in which case the engine may stop suddenly when very warm and start just as suddenly when it cools. The only remedy is a new distributor cap.

The distributor brush, of course, must be in place and must make good contact, interior of cap should be clean and dry.

Let's return, finally, to a consideration of the carburetor. You'll remember that if a few explosions can be coaxed from a balky engine after priming, it shows that the trouble is probably in the carburetor. If the carburetor happens to be equipped with a small jet for low speed running, and another for high speed, the clogging of the low speed jet will stall the engine. The remedy is to clean out the jet.





# The Home Workshop

New and Useful Things to Make with Tools

## How to Build an Electric Washing Machine

By Edwin J. Bachman

**M**OST women declare that of all the work they do around the house, washing the clothes is the hardest, and they dream of some day being the proud owner of an electric washing machine and looking like the immaculate ladies in the advertisements.

Why not, instead of waiting for that far-off day, build your wife, mother, or sister such a machine? I have made several, both power and hand models, at the nominal cost of \$25. Owing to the chance of accident and the additional expense, I have used the hand operated wringer.

The machine described in this article is constructed mainly of cypress and galvanized sheet metal, although copper or zinc may be used in place of the steel.

### What Lumber to Use

The tub sides should be sawed from sound lumber  $\frac{3}{4}$  or  $1\frac{1}{4}$  in. thick; the edges should be square and the different pieces all the same length. The lower boards should be fastened together with aprigs and after the curved line has been laid out, may be cut to shape on the handsaw or by hand. Sawing the boards in this manner will insure a neat job when the sheet metal is nailed on. The mill work may be done at the planing mill where the lumber is secured, and should not cost more than five or six dollars. The sides may be assembled temporarily by laying them in position and nailing light strips across them to keep them from moving.

The galvanized steel comes in sheets 24 in. wide by 72 in. long. Cut off 48 in. to form the ends and curved bottom of the tub. Scribe a line  $\frac{1}{2}$  in. from the edge on the two long sides, and punch or drill holes 1 in. apart along the entire length. These holes should be slightly smaller than the nails to be used so they will fit tightly. Twopenny nails are suitable for fastening the metal.

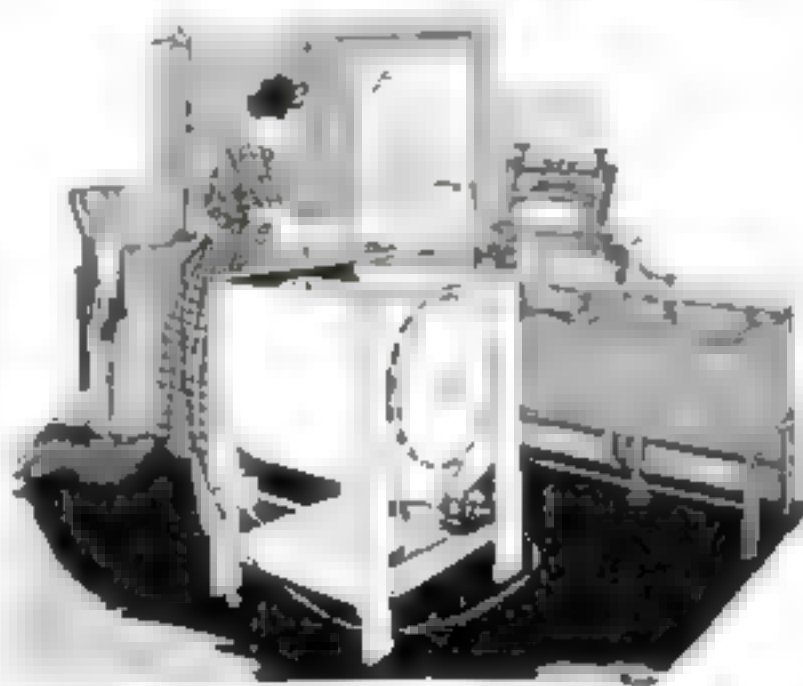
The wooden sides should be set on edge on the floor or bench, so that the curved edges are upward. The wringer supports are placed in position between them and fastened with No. 10 screws  $2\frac{1}{2}$  in. long. Two light strips may be nailed higher up the sides so that the outside measurement at all points is  $23\frac{1}{4}$  in. A vertical line is drawn on each side, passing through the exact center, and another line is drawn across the exact center of the sheet steel. When applying the metal, these lines should correspond.

With the metal overhanging the wooden

sides 1, 16 in., start at the center line and nail it securely. Work both sides alternately, so that there will be no trouble caused by the metal's buckling. Remove the temporary strips as you approach them

side and place two of the legs in position, the ends being flush with the top of tub. Secure these with wooden clamps or with several small nails, and drill  $\frac{1}{4}$ -in. holes through leg and tub. One hole is in the small strip at the top and two in each of the wider boards. For the fastening use  $2\frac{1}{4}$  in. by  $\frac{1}{2}$  in. carriage bolts, with the round head on the inside.

### The One Necessary Labor-Saver



**I**N TENS of thousands of homes the washing machine has become the most essential labor saving appliance. No great progress was made in relieving the drudgery of washing until its invention. It is cost alone that keeps electric washing machines from being used universally. For the man who is handy with his tools, however, the cost of making an electric washing machine is nominal.

Mr. Bachman, the author of the accompanying article, has built several types of inexpensive washing machines, both hand operated and electric, that have worked well, and his instructions, if carefully followed, should insure satisfactory results.

For those readers who wish for more complete details, a larger drawing, and bill of materials, the Home Workshop Department has prepared a blueprint that will be sent upon receipt of 25 cents. A coupon for use in ordering it and other blueprints in the Home Workshop series will be found on another page.

when nailing. After you have nailed the curved bottom, you will be surprised at the rigidity of the tub.

### To Make the Tub Watertight

When the entire length has been nailed on, the ends should be bent over the wringer supports and fastened in the same manner. The  $1\frac{1}{8}$ -in. overlap is next peened over with a light hammer. This will make a joint that is absolutely watertight. The side boards are held in contact with each other so tightly that after water has once been in the tub, there will be no leakage whatever. The writer constructed a tub in this manner in 1918 that has not leaked to date, although it is in constant use.

This accomplished, lay the tub on its

### The Motor Shelf

Secure the legs on the other side in the same manner and stand tub upright. Two pieces of  $\frac{3}{4}$  by 2 in. stock, 26 in. long, are fastened to the inside of legs to support the motor shelf. The drawing shows this member with an area as large as the floor space of the machine. This is not entirely necessary, as the motor occupies very little room and the countershaft is not mounted thereon, but it will add to the rigidity of the machine. The countershaft bearings may be bolted to the legs before drilling to receive the bushings. By measuring equal distances from the floor to the center of each, the shaft can be kept perfectly level.

A rotor with short paddles is often used in large laundry washers and many household type machines, and these are equipped with a reversing mechanism, so that the clothes will not roll up in a ball. Few home workers are prepared to build so complicated a mechanism, so we can make the rotor in a simpler manner.

One way is to make a rotor with a wooden partition. In this type the wash is divided and placed on each side of the board and the lid of the rotor opens directly over the edge so as to make all parts accessible.

The board is drilled full of 1-in. holes 1 in. apart and is held in place by two clamps fastened to each rotor head. A heavy galvanized wire netting of about  $\frac{3}{8}$ -in. mesh is used to cover the rotor, except where the wooden lid is fastened on.

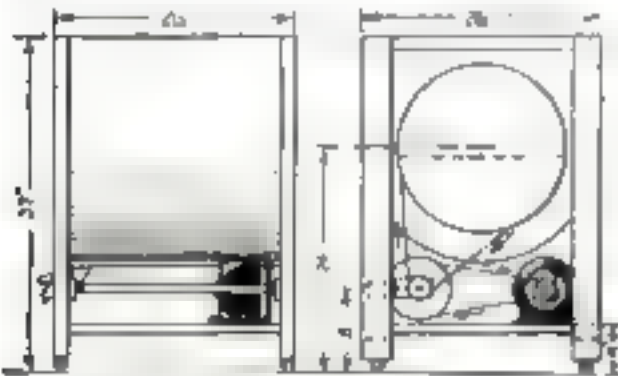
Another method, which is illustrated in the rotor detail on page 78, makes a very strong barrel. The short paddle in the center has the advantage of not rolling the wash into a ball. The curved sides are sheet metal and are fastened in the same manner as the bottom and sides of the tub. The straight sides are wooden ones, being made easily detachable, and are drilled full of 1-in. holes to allow the water to flow freely.

The lid for the machine is a square frame, 26 in. on a side, made of  $\frac{3}{4}$  in. by 3 in.



strips. On this is nailed centrally a 24-in. square of the sheet metal. This will allow the wooden frame to project 1 in. all around, eliminating the danger of cutting oneself on the metal edge. The cover is shown hinged to the tub, but the hinges may be omitted and the lid removed entirely if preferred.

The simplest way of providing a drain is to drill a 1-in. hole in the wooden tub



Front and side views, showing general dimensions

side opposite the drive and close to the bottom, and fit it with a tapered wooden plug. This was the standard practice for a long time. Lately, however, the plug has been replaced with a metal faucet. The reader may use his own judgment in providing an outlet.

The countershaft is a piece of  $\frac{3}{4}$ -in. cold rolled stock, 27 in. long. Two grooved pulleys, one 6 in. and the other 3 in. in diameter, are needed to fit the countershaft. They should be provided with set screws.

The motor may be a standard  $\frac{1}{8}$  or  $\frac{1}{4}$  hp., such as those regularly advertised at prices ranging from \$10 to \$15. It

must be fitted with a  $1\frac{1}{4}$ -in. grooved pulley.

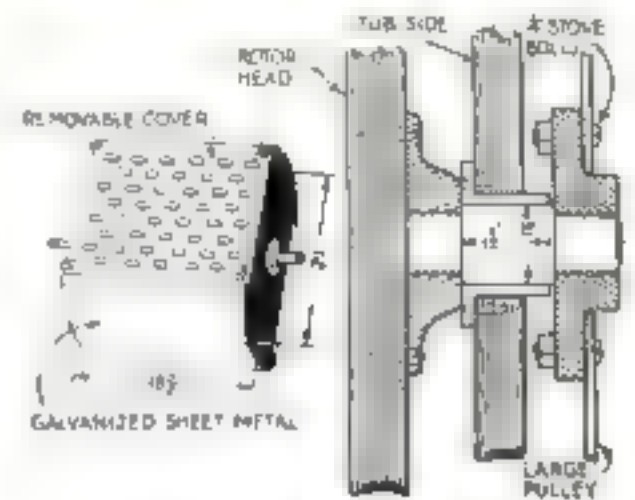
To drive the barrel, the ordinary 18-in. grooved or flat pulley is hardly positive enough. A six-to-one chain drive could be substituted here, but the purpose of this article is to show how the machine can be made at home, and few amateurs have shops equipped for making a chain drive. Instead, with a beam compass draw a 20-in. circle on No. 18 gage sheet steel and then an 18-in. circle concentric with the first one. After cutting out the larger one with a pair of heavy shears, divide the outside edge into an equal number of sections about 2 in. long. With a chisel or shears make a 1-in. gash at each mark. This gash should go to the 18-in. circle and no farther. With a pair of heavy pliers, bend the sections alternately to 45 degrees on either side of the center line. The gashed edges should be slightly rounded so the belt will not be cut. With a  $\frac{3}{4}$ -in. or  $\frac{1}{2}$ -in. round belt, zigzagging along the circumference, we have a drive that is positive even if the belt should sag.

### For the Main Shaft

The large pulley may be riveted or bolted to the flanged shaft. A smaller idler may be used to keep the belt in good contact with the small pulley.

The main shaft, which is shown in detail, has a thread cut on one end to fit the tapped hole in the rotor. This drives in the same manner as the faceplate on a lathe, and permits the barrel to be removed easily. A short flanged shaft is fastened to the opposite end of the rotor and runs in a half bearing. It is held in place by a

simple latch. A guard is necessary over the belts and pulleys. If a professional finish is desired, it is well to incase the machine in metal. When enameled, the



The rotor and detail of its shaft

washer will be a household utility you will be proud to own.

If you wish more complete working details of this washer and a bill of materials, send 25 cents for Blueprint No. 12.

### Photographic Enlargements Used as Advertising Signs

**S**IGNS suitable for window displays and other commercial purposes can be made by using photographic enlargements of small printed cards or typewriting. A Washington, D. C., photographer recently made a sign 12 by 24 in. from a 2 by 4 in. card. When only one sign is to be made, this photographic process is probably as reasonable as any other.—A. G. L.

## Learn Wireless Code with This Homemade Transmitter

By J. E. Pettibone

**E**VERY one who makes or buys a radio receiving set soon becomes curious to read the code messages that he can tune in at any time of the day or night. These messages, he quickly learns from other more experienced radio fans, are often most interesting—news despatches, witty interchanges between amateurs, messages between ships and shore stations, army and navy despatches, and all kinds of wireless traffic. These messages keep many a radio "ham" up long after the regular broadcasting programs have shut off for the night, because they are frequently as entertaining as the radio-phonograph programs.

To enjoy them, however, it is necessary to master the code, and that is not so easy. It is like a foreign language in that it is much easier to learn to send the dots and

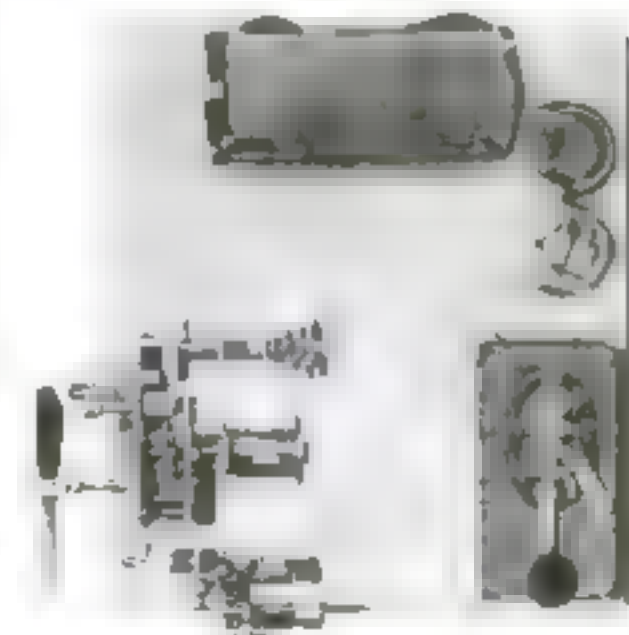


Fig. 2 Top view, showing transmitter, battery, buzzer, and key

dashes than to read them. One good way to learn is to make an automatic telegraph transmitter that will send code messages at varying rates of speed. Such a device is the one illustrated. It is practical and one that can be made by almost any one who is mechanic enough to construct a radio set. It has the advantages of being both efficient and cheap, and any number of messages may be prepared quickly for use in connection with it.

The apparatus was made mainly of pieces I had at hand in my own workshop. The operation of the machine is along the lines of a player piano. Suitable holes are punched in a length of old motion picture film, No. 17, Fig. 3, which is passed over the rollers in such a way that contact is

made through the holes. It will be seen that the film has two rows of holes, so that if contact is made through both sets at the same time, one contact piece, No. 12, Figs. 1, 2, and 3, being connected with one buzzer, No. 10, and a similar contact piece being connected with another buzzer, practice in reading signals through interference may be had. In that case, both buzzers should have slightly different tones.

The old film may be obtained at a nominal price from almost any place where developing is done. It is wound on a holder, No. 3, Fig. 2, made from a piece of  $\frac{3}{4}$ -in. brass tube bent into an inverted L shape. Retaining disks cut from aluminum or other sheet metal are provided on this spindle. The outer disk is held in place by a thumbcrew so that it may be removed readily. The distance between the disks is somewhat greater than the width of the film, the additional space being taken up

(Continued on page 114)



Fig. 3 The punch, marking wheel, perforated film, and contact piece

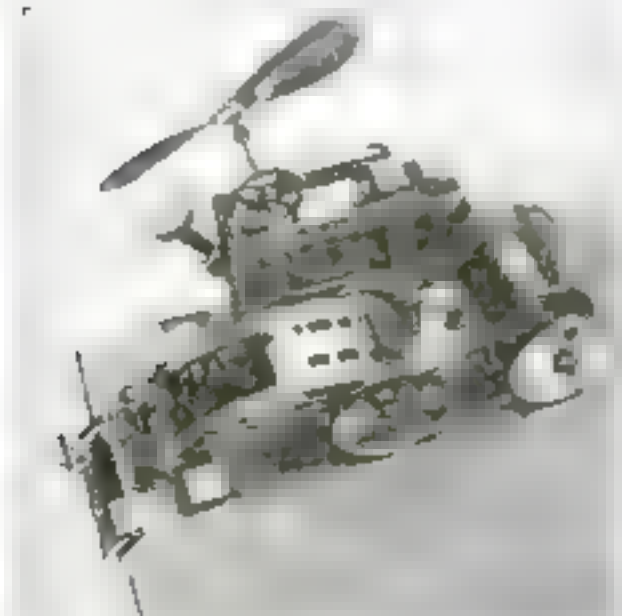


Fig. 1 General view of the automatic telegraph sender



# This Decorative Floor Lamp with Caned Pedestal Can Be Made with Few Tools

**PROPER** lighting contributes much to the comfort, charm, and individuality of a living room at night. Poorly placed lighting fixtures of crude design, throwing either too much or too little illumination, will counteract the effect of furnishings that are in the best of taste. But even glaring and inartistic lighting can be controlled and improved by the use of well-designed floor and table lamps, and of those varieties that can be made with the tools available in the average home workshop, few floor lamps are more attractive than this one with its caned pedestal—THE EDITOR.

**B**EFORE beginning the construction of this lampstand, it is best to make a frame or pattern for the upper and lower sections. This will make it easier to obtain the correct angles and good, tight joints. The frames can be made of any scrap material at hand, and should be of

By Herbert A. Mincher

same type of joint, and are similarly drilled.

The next step is to cane these sections. This is done at this stage because it would be impracticable to do the caning after the pedestal was assembled. No one need hesitate to attempt the caning, because this is very much easier to do than it looks. It requires only a little patience and care, and the finished weave or pattern is certain to be much more regular and attractive than a beginner in caning would expect. Caning does not, indeed, demand the practice or skill required in woodwork or finishing.

To make the cane flexible and easy to work with, and to keep it from breaking, it should be soaked in water beforehand and kept well dampened throughout the caning process. First, starting at the center hole at the top and the center hole at the bottom, weave two strands of cane vertically through each hole in the top and bottom members of the frame being canted. It is very important that these should not be drawn too tightly or it will be difficult to push through the fifth and sixth strands of cane.

## Weaving Horizontally

The next strands are woven in a horizontal direction, alternately over and under each of the vertical strands. The caning will now appear as in detail E, forming a series of parallel vertical and horizontal lines with open squares between.

The next strands, which are single, run diagonally, from the lower left-hand corner to the upper right side. They go under the vertical pairs and over the horizontal pairs immediately to the right of and above the vertical ones, as shown in detail F. The diagonal lines of cane that complete the operation go from the lower right-hand corner to the upper left-hand side and always pass over vertical groups and under horizontal ones.

The cane is fastened at the beginning and end, and wherever else necessary, by the use of small wooden plugs driven into the holes. When a new length of cane is added, the joint is, of course, made at a hole. It is well to make several wooden plugs that can be stuck in temporarily here and there on top to hold the cane in place while working. It will be found that after the last strand has been woven through, the under layers are bound tightly.

A little ingenuity will solve any problems in weaving that arise in this or any other piece of ordinary cane work.

A length of binding cane, wide enough to cover the holes, is laid along over the holes and is fastened with a piece of fine cane

that is run up through every other hole, passed over the binding strips and down through the same hole.

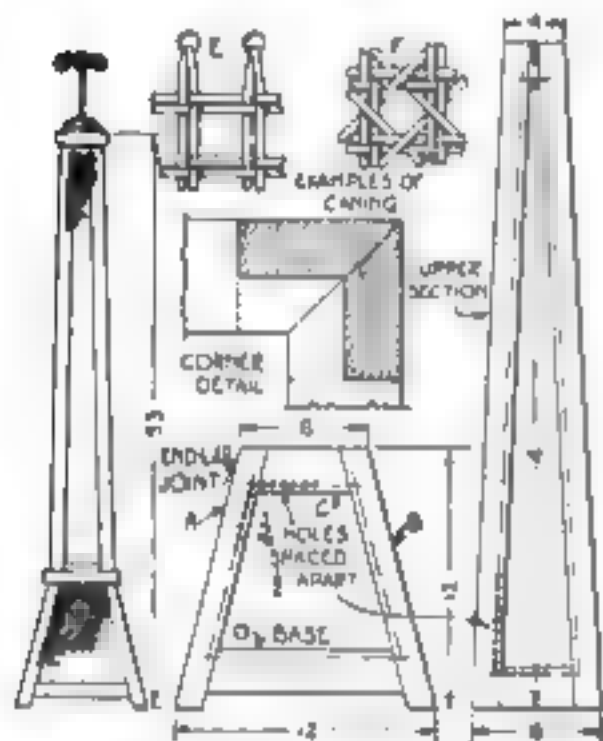
After the sections have been caned, they are assembled. They should be glued together and clamped until dry, care being taken that the joints are tight and the sections square.

When they are dry, a piece of scrap lumber is fastened in the smaller end of the lower section and the lower end of the upper section, and a hole is bored in the center to take an ordinary  $\frac{3}{4}$ -in. pipe, which serves as a conduit for the wiring. Two holes for  $\frac{1}{4}$ -in. or smaller bolts also are drilled. These bolts hold the upper and lower sections together.

A piece of oak, approximately 4 in. square, fitted on top of the upper section, and 4 pieces of  $\frac{1}{2}$  in. by 1 in. oak are bevelled to fit around this piece, forming a frame to trim the cap so that no end grain will show. A hole for the  $\frac{3}{4}$ -in. pipe is drilled through this cap. The joint between



The lamp complete with shade

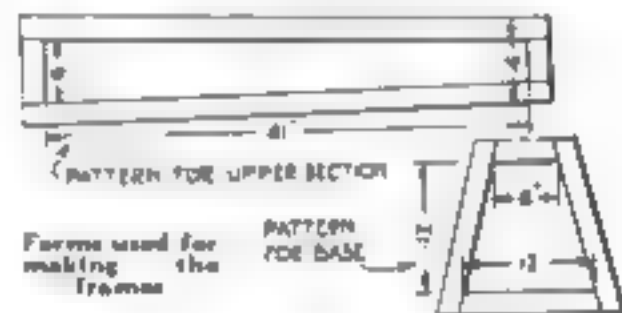


Details of the frame and caning

the else end shape shown in the accompanying details.

In making the base section four frames will be required. First cut the upright pieces, A and B, to fit in the pattern. Then lay out pieces C and D, so as to make end lap joints with pieces A and B. When the joints have been neatly fitted, glue them and nail them with small brads. Then the frames are ready to be drilled with 3/16-in. holes, approximately 1/2 in. apart, center to center, as shown.

The four frames for the upper section are made in the same manner, with the



the upper and lower sections is also covered with trimming pieces  $\frac{1}{2}$  by 1 in.

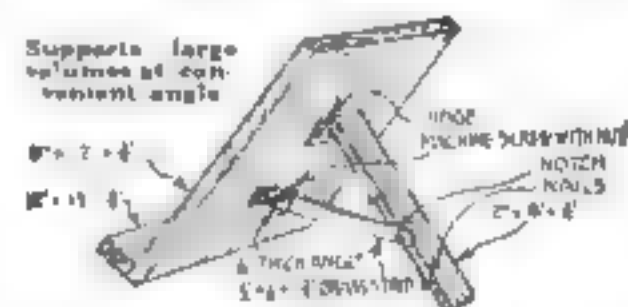
A piece of  $\frac{3}{4}$ -in. pipe is then run down through the center, and the light socket and stand are screwed on top of it. The pipe should be so cut that when the light socket is screwed on, it will draw up tight. The coupling on the end is used as a nut.

The lamp is then ready for varnishing. Stain of any color desired can be used.

The stand is intended for a large shade of the variety shown, although almost any style of shade of any material may be used.

## Easily Made Adjustable Bookrest

**W**HEN reading a large volume or making many notes from a book, an adjustable rest such as is illustrated will



add considerably to one's comfort. The angle is changed by adjusting the hinged leg by means of a notched brass strap, which engages nails that project from the edge of the leg. FRANK HARAZIM.

## Tools and Materials Needed for Making the Lampstand:

### THE tools required are

Hammer  $\frac{3}{4}$ -in. chisel  
Saw Plane  
Square Small miter box  
Brace and 3 1/8-in. wood bit

### The materials required are

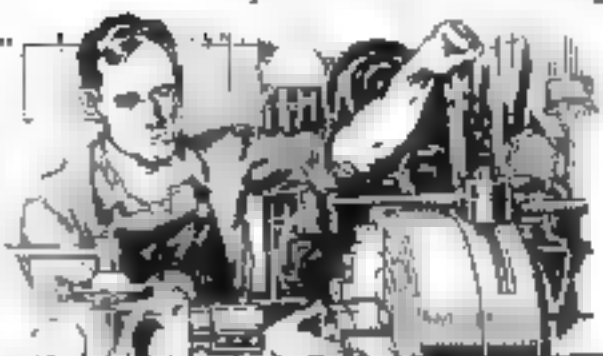
36 ft.  $\frac{3}{4}$  in. by 1  $\frac{1}{4}$  in. oak, beveled 45 degrees on one edge, for vertical members  
8 ft.  $\frac{1}{2}$  in. by 2 in. oak for horizontal members  
4 ft.  $\frac{1}{2}$  in. by 1 in. oak for trim  
1 piece oak  $\frac{3}{4}$  in. by  $\frac{3}{4}$  in. by 4 in. for top  
1000 ft. superfine cane, 30 ft. binding cane  
1 length of  $\frac{3}{4}$  in. pipe for wiring conduit  
3-way electric socket and stand  
Lamp cord  
2  $\frac{1}{4}$  in. or smaller bolts, 1  $\frac{1}{2}$  in. long

**THE** Home Workshop is continued on page 90. It contains nearly half a hundred more useful and money-saving suggestions for men who like to work with tools.



# Better Shop Methods

How Expert Mechanics Save Time and Labor



## Four Useful Tools that Any Machinist Can Make Easily

### Boring Chuck, Center Punch, Taper and Scratch Gages



Center punch, scratch gage and two sizes of taper gages

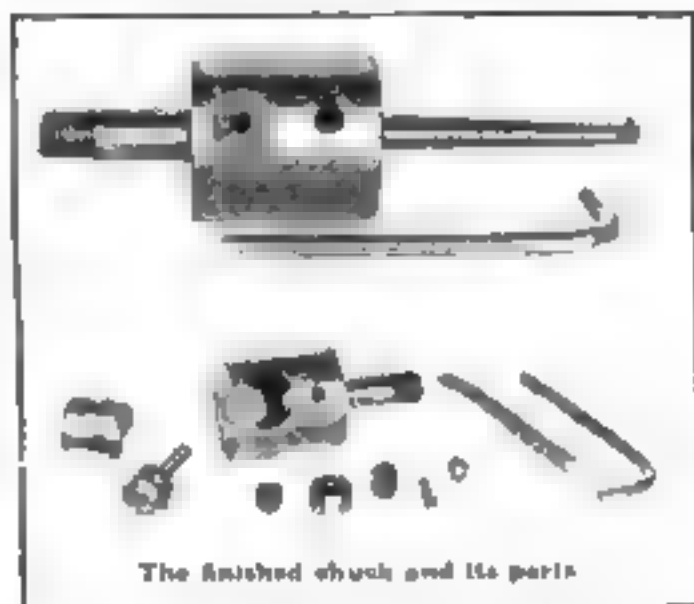
**M**ACHINISTS who are on the lookout for time and labor saving tools to add to their tool kits will find useful suggestions in the accompanying drawings, which give complete details for an eccentric boring chuck, a milling machine center punch, a taper gage, and a scratch gage.

The features of the boring chuck are its simplicity, few parts, and range of tool movement for the size of the chuck. The  $\frac{1}{2}$ -in. and  $\frac{1}{4}$ -in. holes were counterbored and reamed with a machine reamer on a milling machine, using the dividing head. The counterbores were used by Mr. S. L. Roberts, who designed and made the chuck, so that the two holes would be as nearly parallel as possible without the necessity of boring them at all.

It is interesting to note that Mr. Roberts uses a set of counterbores all of which are from .001 to .008 in. under standard reamer sizes and finds them serviceable in work requiring dowel pins and the like. In shops where there is no complete set of letter size drills, these counterbores are handy because it is obviously better to ream out .008 in. than perhaps nearly .015, as in the latter case the hole is more apt to be oversize.

The follower or nut (7), after a  $\frac{1}{4}$ -20 left-hand tap has been run in it, is cut with a 1 16-in. saw as shown and the parts on each side of the slot are sprung together. A hole is then taper reamed for a No. 1 taper pin, which is pressed in lightly so as to expand the nut. Should there be any wear on the nut or screw, the pin may be driven out a trifle and the nut closed so as to take up any lost motion in nut and screw. No adjustment, however, has so far been required of the original chuck, although it has been subjected to considerable hard usage. The nut and screw are tool steel, No. 8 being hardened only to the threads. The  $\frac{3}{16}$ -in. setscrew (6) also is hardened.

The milling machine center punch is used for laying out centers on work quickly and accurately with the aid of a milling machine; it also can be used for scribing



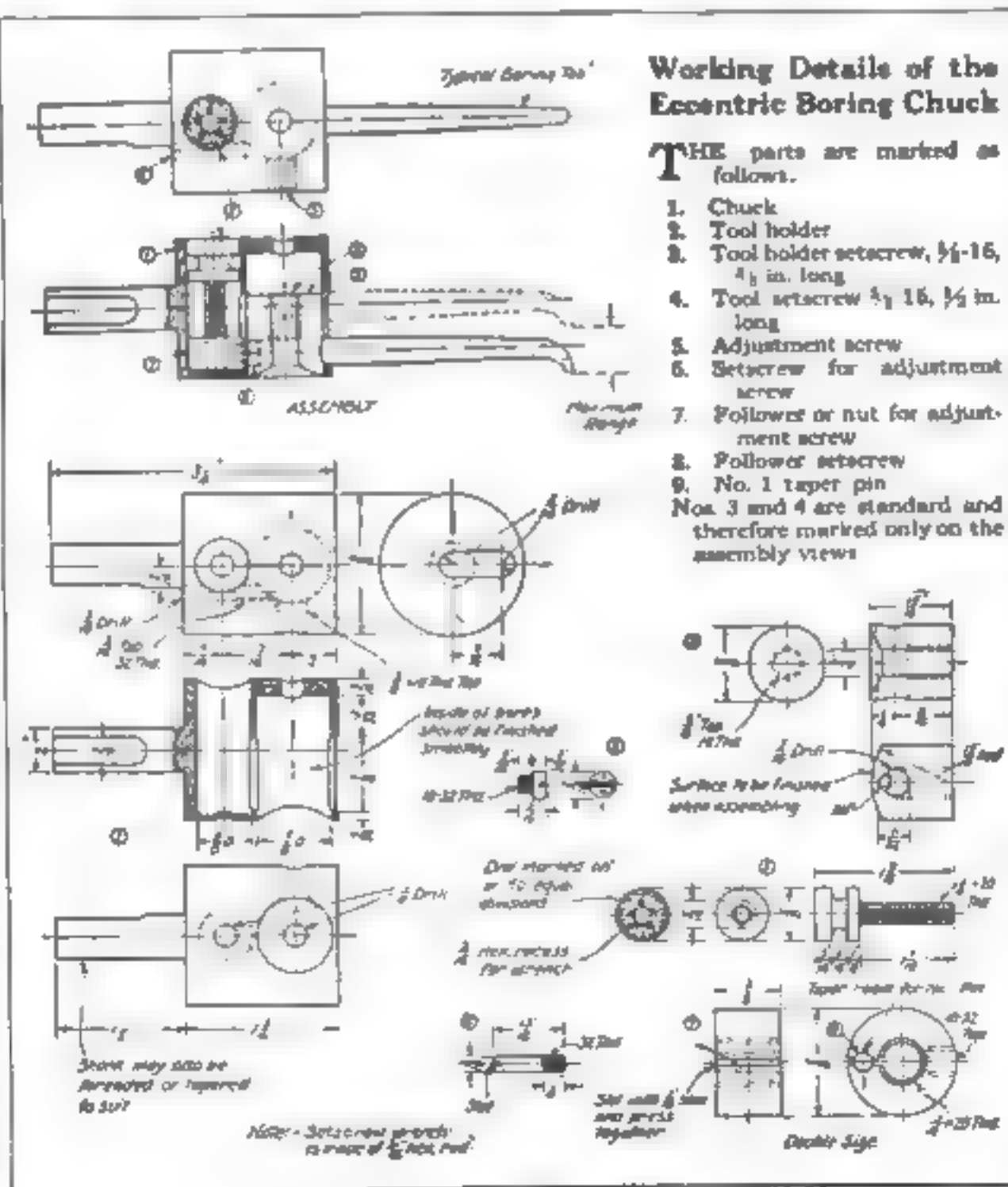
The finished chuck and its parts

lines. The body is of mild tool steel and the plunger is made of a 3.16-in. drill rod. A heavier plunger may be used if desired.

The 1-in. hole fits over the milling machine arbor, and if a smaller arbor is used, it can be built up with rings. The hardened point of the plunger should be a close fit in the holder, the hole in which should be perfectly parallel with the sides.

In use the plunger is fastened on the arbor just as a cutter, the plunger being approximately vertical. Fasten the work on the milling machine table and bring it to within  $\frac{1}{4}$  in. of the plunger point. Locate the first center and tap the punch. Move the table to the next position, using lateral and cross feed dials for distances in either direction. This will be found accurate enough for ordinary work and is a very speedy method.

The taper gage, which can be made in various sizes to suit the sizes of work ordinarily handled, is useful for finding the taper for every foot in the spindles of lathes, milling machines, drill presses, lathe tailstocks, etc.



### Working Details of the Eccentric Boring Chuck

THE parts are marked as follows.

1. Chuck
2. Tool holder
3. Tool holder setscrew,  $\frac{1}{2}$ -16,  $\frac{1}{2}$  in. long
4. Tool setscrew  $\frac{1}{2}$ -16,  $\frac{1}{2}$  in. long
5. Adjustment screw
6. Setscrew for adjustment screw
7. Follower or nut for adjustment screw
8. Follower setscrew
9. No. 1 taper pin

Nos. 3 and 4 are standard and therefore marked only on the assembly views.

Double Size

(Continued on page 88)



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## Handy Chart Quickly Gives I-Beam Facts

THIS ready-reference chart tells all about I-beams almost at a glance.

By W. F. Schaphorst

It serves more quickly than a table for solving many problems of frequent occurrence in construction work and gives close results for regular standard beams. For "special" beams, however, caution should be exercised in applying it.

I-beams are much used and certainly will be used more and more for holding concentrated as well as uniformly distributed loads. The I-beam is the lightest and most economical steel beam for most purposes.

In as much as a concentrated load requires the largest beam for a given load, this chart is based upon concentrated loads for the sake of safety.

The wavy lines with arrows running to the vertical chart lines show at a glance just what each chart column means. Thus, Column A gives the length of the span in feet and includes all lengths from 1 ft. to 40 ft. Column B gives the weight of the I-beam in pounds per foot, and includes all weights from 1 lb. to 200 lbs. Column D gives the safe load of the I-beam in pounds and varies from 400 to 30,000 lbs. Column E gives the depth of beam in inches from 1 to 10, as shown.

Let us suppose that a weight of 4000 lbs. must be lifted. A 7-in. I-beam weighing 340 lbs. is available. It is 12 ft. long and

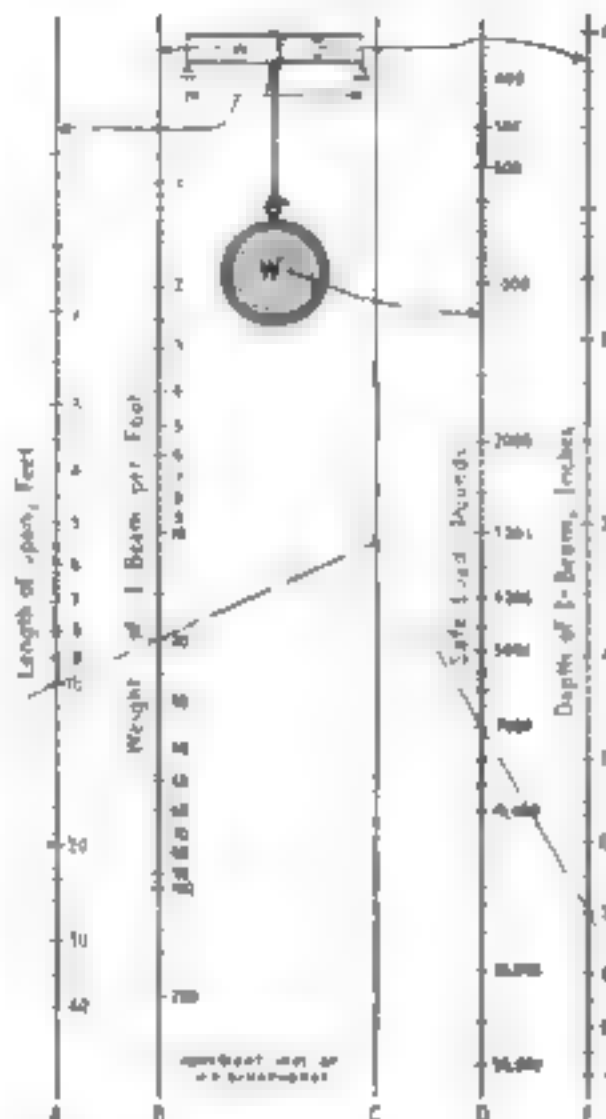
therefore weighs 20 lb. per ft. The minimum distance between supports that can be obtained for the lifting operation is 10 ft. Can the I-beam lift the 4000-lb. load?

The dotted lines drawn across the chart show how the problem is solved by means of the chart. Run a straight line through the 10 ft. (Column A) and the 20 lb. (Column B) and locate the intersection in Column C. Then from the intersection in Column C run over to the 7 in. (Column E). The intersection through Column D shows that the I-beam will support 7000 lbs. Since the load to be lifted is only 4000 pounds, the beam is simply strong. In fact, the reader will see that a 4-in. I-beam, all other conditions being the same, would safely support the load of 4000 lbs.

Similarly, it is easy to ascertain the maximum allowable span when the factors in Columns B, D, and E are known. Or, the necessary weight per ft. of I-beam may be determined when the factors in Columns A, D and E are known. Lastly, the depth of beam is determinable when the factors in Columns A, B and D are known.

For loads that are "uniformly distributed"—not concentrated—the safe loads in Column D may be multiplied by two. Thus, the above described beam will support a uniformly distributed load of 14,000 lbs., or 1400 lbs. a running foot.

### For Your Shop Notebook



This chart saves consulting tables and making calculations in regard to I-beams. Given any three facts about a beam, the fourth can be ascertained graphically by two lines drawn through the known points to intersect in C, as shown.

## Cotter Pin and Staple Puller for the Hammer

THE home mechanic, the garage repair man and the carpenter, when working on certain jobs, will find this cotter pin and staple puller attachment a useful addition to his hammer.

A piece of stub steel is squared up at one end; the other end is rounded and threaded for a nut. The squared end is tapered down to a round point and bent as shown and a reverse taper is filed on the short end of the bend where it meets the round section. The piece is then hardened and drawn to a dark brown color, which removes the temper and leaves the steel tough and stiff.

The hammer head is then dried and the side of the hole is filed square to fit the bent tang, which is inserted and drawn up tight by the nut on the other side. The threaded nut is filed off smooth and the threads slightly battered, in order to prevent the nut loosening.

The safest way to use the tang is to have it turned downward, as shown, although



A hardened steel tang is fastened to the side of the hammer.

most mechanics would prefer it turned up, in which position it is somewhat easier to use.—C. H. S.

### Choosing Steel for Gages

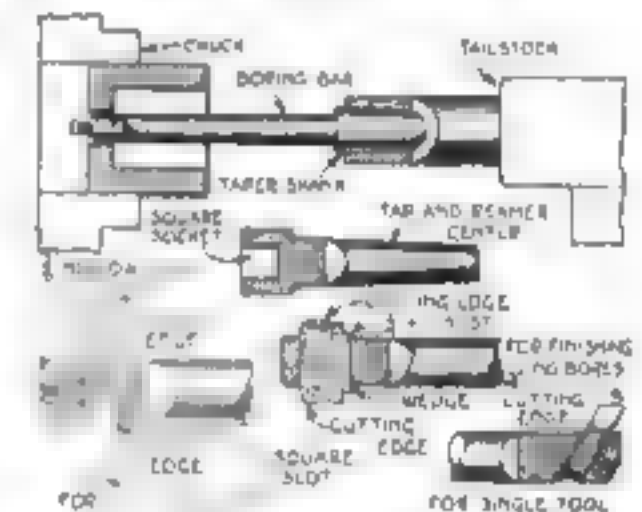
THE selection of material for gages depends largely on the gage to be made and its use. For flat or profile gages and templates a good grade of low carbon or machine steel can be used. Plug and ring gages require a higher grade of tool steel. Steel for thread gages should be selected with great care. A fine, close grained steel, should be chosen.

## How to Make and Use Tailstock Boring Bars

MOST machinists and lathe operators look upon the tailstock of a lathe as a part of the machine designed only for the holding of the dead center, drills and reamers. The tailstock will save many hours of needless time and labor and make for better work and bigger production if full use is made of it for boring. How often do we see a mechanic using a slim boring tool, set up in the toolpost of the carriage, taking cut after cut from a cored hole in a fruitless endeavor to get the hole true?

Take, for example, bronze bushings, cast in halves and sweated together. These invariably have hard and soft spots; the hard spots shove the tool away so that unless the hole is reamed in finishing, the workman can bore away for hours trying to get a straight hole to accurate size.

On just such a bronze bushing job, the writer was able to speed up his production 50 per cent by using the slim, long boring bar illustrated. It was fitted with a broad



Boring tools for the tailstock

double cutter, held with a steel wedge key. The bushings were roughed quickly to within a few hundredths of an inch of size, and the double cutter then finished them accurately to size and perfectly straight. The bar fits into the No. 3 socket of the tailstock spindle and is fed through the bore by hand feed, the width of the cutting edge being sufficient always to overlap any unevenness in the feeding.

For the rapid counterboring of holes, the single sided tool is slow compared with a double cutting  $\frac{3}{4}$ - or  $\frac{1}{2}$ -in. high speed tool bit, placed centrally in the end of a stout boring bar held in the tailstock. With the single tool, many cuts must be taken, but with the double cutter, one cut is usually sufficient.

The tailstock is admirably suited for holding a heavy bar and even for single-sided tooling purposes is ideal, as its rigidity prevents any springing away of the tool from the cut.

A good bar for general use is the one with the slantwise tool slot on a 30-degree angle. This style of bar should be made up in several sizes.

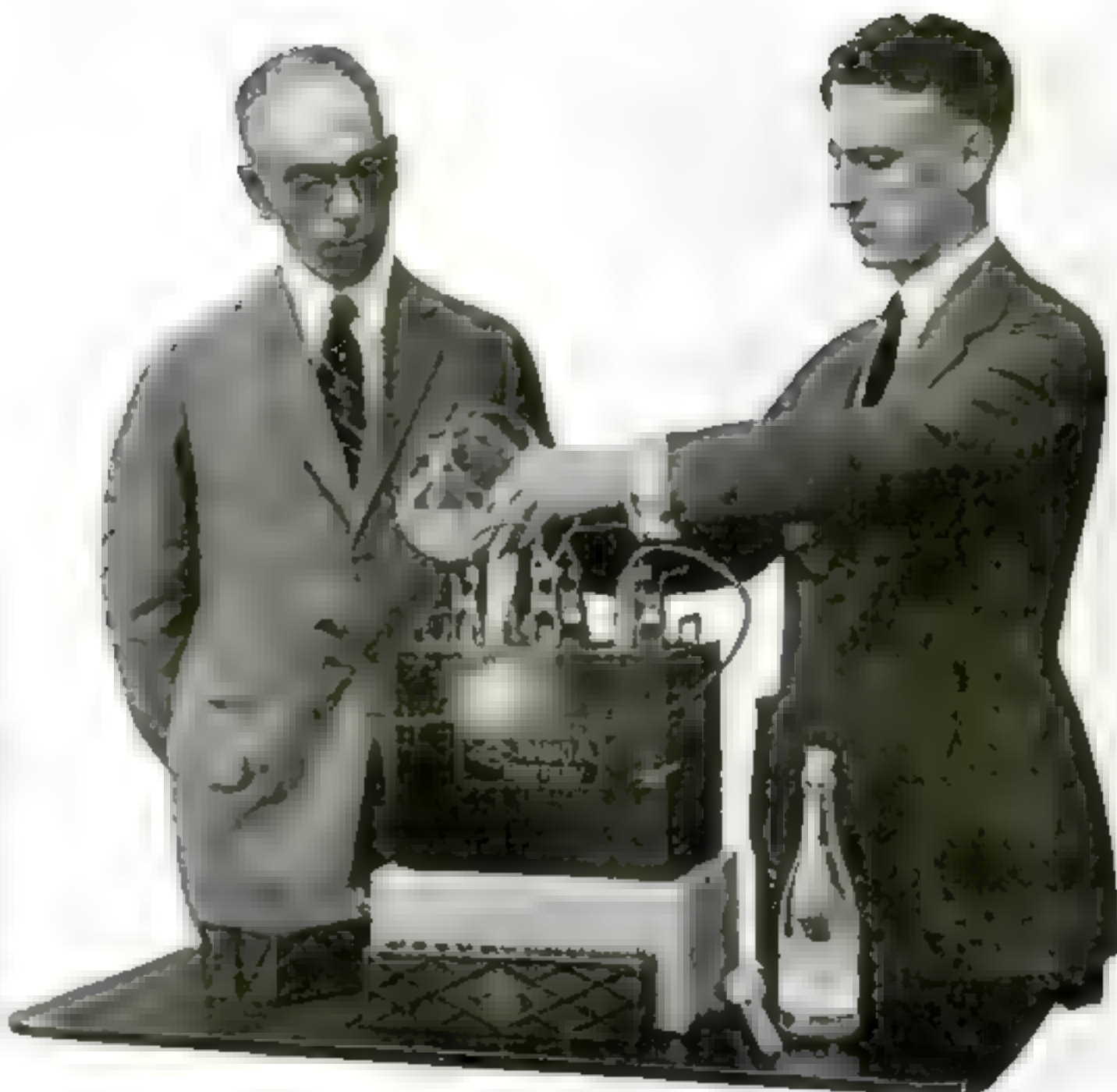
The advantage of bars with the square tool bit slot lies in the fact that tools are easily made by mechanics themselves by grinding self-hardening tool steel.

Many a bore of an odd size, for which there was no reamer handy, has been finished up perfectly true and to size by the writer with double cutters made of square bit stock. J. V.

THE weight of sheet iron can be computed by multiplying the thickness by 40. This gives the weight in pounds a square foot.



Engineers of the Philadelphia Storage Battery Company demonstrating to an assemblage of battery experts at Atlantic City the revolutionary features of the new Philco Radio Batteries equipped with "Philco Process Plates". A Philco Radio "A" Battery, assembled in full view of the audience, and without initial charging, developed full power on the pouring in of the Philco electrolyte—a history-making achievement. The Philco Radio "B" Battery is shown in the foreground.



## A history-making achievement in battery engineering

Now—for the first time in history—you can equip your radio with batteries born the day they're first used—storage batteries that are full-powered and 100 per cent new when you get them.

The new Philco Radio Batteries, with their remarkable "Philco Process Plates"—a revolutionary development in battery engineering—are **CHARGED DRY** at the factory. Their life doesn't start until you pour in Philco electrolyte.

This means that you can now get absolutely fresh, charged radio batteries—not partly worn out batteries that have lost charge and wasted away in the dealer's stock.

Philco Radio "A" Batteries have all the time-tested features of the famous Philadelphia Diamond-Grid Batteries—the standard for automobiles, mine locomotives and other heavy-duty purposes.

They give a uniform flow of voltage that assures absolute freedom from "cracking", "frying" noises and eliminates need for constant adjustments. Because of their Philco Retainers, they hold their charge longer than any ordinary battery, they are conservatively rated and will deliver all the electricity the name plates say they will deliver, and they are guaranteed for two years.

The Philco Radio "B" Battery, with its 24-volt capacity, takes the place of 15 dry cells and occupies far less space. Its 12 cells are neatly and compactly sealed in an attractive one-piece hard rubber case—a fit companion for the finest radio outfit.

Ask your radio dealer to show you these remarkable Philco Batteries, or go to any Philadelphia Diamond-Grid Battery Service Station.

Philadelphia Storage Battery Company, Philadelphia

**PHILCO**  
SLOTTED RETAINER  
BATTERIES

with the famous shock-resisting diamond-grid plates

**RADIO DEALERS**—Philco Dry-Charged "A" and "B" Batteries let you enter the battery business on a package-goods basis, because they're shipped to you charged but absolutely dry. To make ready for use, just add conveniently bottled Philco electrolyte. No charging equipment. No acid sloppage. No batteries going bad in stock. Your customers are sure to get fresh, full-powered batteries. Wire or write for details.

Mail this coupon today  
See I want to know more about the new Philco  
Radio Batteries.

Name \_\_\_\_\_  
Street \_\_\_\_\_  
City \_\_\_\_\_ State \_\_\_\_\_  
Business \_\_\_\_\_





## "WALLY" REID

Star of the Movies, Plays a

# BUESCHER

## True-Tone Saxophone

While not chosen as a musical star Wallace Reid's saxophone afforded him much pleasure in some short silent spots. His decision to purchase a Buescher was made after knowing it to be the

## Choice of Professionals

such as Tom Brown of the Six Brown Brothers, the Harry of the famous Art Hickman's Orchestra and many other famous players. Buescher's saxophones are the choice of professionals because they are

## Easiest to Play

You can learn the sax in an hour's practice and play popular music in a few weeks. Practice is a pleasure because you learn so quickly. You can take your place in a band in 10 days of no practice.

It is good for home entertainment, church, lodge or club. In big bands too up to a dance music. A saxophone will do for you to take an important part in the musical equipment of an orchestra. It is a valuable asset and your opportunity, as well as your pleasure.

## Saxophone Book Free

The Right of the Saxophone is an interesting booklet. It illustrates the beginning of a first lesson. It tells what each saxophone is best adapted for when to use single in your band or orchestra or in regular band or full orchestra. It tells how to play and the parts to be learned. It illustrates and tells the names of each model of the saxophone family. Ask for your copy. The booklet of the most successful professionals use Buescher's Saxophone, Trumpets, Trombones and other Band and Orchestral Instruments.

## Free Trial-Easy Payments

You can order any Buescher instrument without paying one cent in advance and it will be delivered to your own home without obligation. If you are satisfied pay for it in easy payments to suit you. If not, return it. Meanwhile the instrument is yours and a complete catalog will be mailed free.

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Makers of Everything in Band and Orchestral Instruments

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Kindly mail to me Saxophone Book.  
Should you also send me free complete Catalog of all Buescher True-Tone Band and Orchestral Instruments.

Name

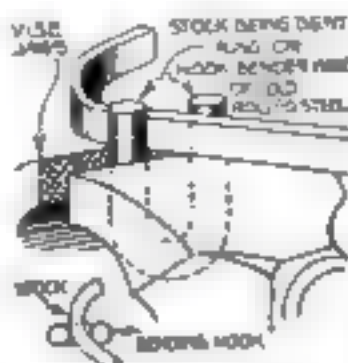
P. O. Address

Instrument I play is

## BETTER SHOP METHODS

### Simple Ring Bending Fixture for Forge Shop Vise

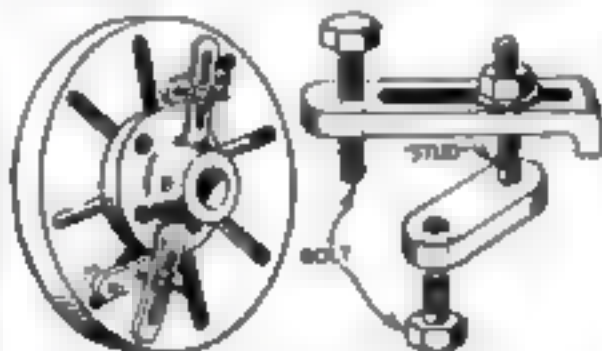
WHEN it is necessary to bend rings or hooks from flat or round stock, the bending fixture shown may be used to advantage. It consists only of a U-shaped section of heavy barstock. This tool is clamped in the vise and the stock to be shaped is placed between the ends of the tool and bent to the desired shape. Several of these fixtures and a heavy vise will afford means for bending almost any stock that is apt to be handled in ordinary work.—L. A.



For making bands

### Handy Faceplate Straps

IT IS sometimes difficult to fasten work to a lathe faceplate with the ordinary faceplate straps. To overcome this, I have

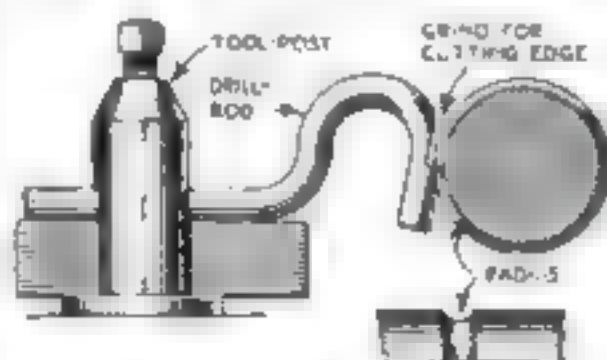


For holding work of awkward shape

made up several clamps as shown. They have proved a great help in holding work of an awkward shape, and have the additional advantage of requiring no blocking.—C. W.

### An Easily Made Radius Tool

IT TAKES no little time to grind a radius tool, and without a radius gage it is hard to form the radius exactly correct in size. The accompanying illustration, however, shows one satisfactory way to make a gooseneck radius tool. The method is



Made from drill rod bent, ground, and hardened

so easy that a mechanic can make the tool in a very short time.

Take small pieces of drill rod of a size to form the radius required and bend a hook in one end. Grind one half of the hook in front as a cutting edge. After hardening, the tool is ready for use.

I now have almost all sizes of radius tools of this type and find that they are excellent and do not cause any chattering or roughness of cut.—C. E. KLINT



## "Why the menagerie?"

YOU wouldn't stand for a young menagerie howling around the house. Why permit your radio set to act that way? It's unnecessary. For just five dollars you can add an Acme Audio Frequency Transformer to your set. This ends the howling and distortion so prevalent in the ordinary detector unit and at the same time it greatly increases the volume of incoming sound. Music and the human voice assume their natural tones. No more thin squeaky voices and tiny elfin wails.

You will also want the Acme Radio Frequency Amplifying Transformer. You can use it with either a vacuum tube or a crystal detector set. It greatly increases the distance over which you can receive broadcasting programs. Just the same price as the Acme Audio Frequency Transformer. Two stages of Acme Audio Frequency Amplification with two stages of Acme Radio Frequency Amplification will give you maximum range, volume and certainty of natural tone. Your set is incomplete without them.

The Acme Apparatus Company (pioneer transformer and radio engineers and manufacturers) also make detector units, detector and two stage amplifying units, the Acme Clear Speaker, the Acme Phone, also C. W. and spark transmitting apparatus. Acme Apparatus is for sale at radio, electrical and department stores. If one is not close at hand, send money direct. Ask also for interesting and instructive book on Transformers. The Acme Apparatus Company, Cambridge, Mass., U. S. A. New York Sales Office, 1270 Broadway.



Type A-2 Acme Amplifying Transformer  
Price \$5 (East of Rocky Mts.)

# ACME

for amplification



THE BLADE ACHIEVEMENT  
THAT ANTIQUATES OLD WAYS

# Now Comes the World's Fastest Shave

78 Seconds from Lather to Towel!

—We offer it to you

WE worked for years to make the following facts true. Now, if you'll lend us a few seconds reading them, we'll pay you back with interest compounded tomorrow. They change the whole shaving situation. Old methods are supplanted.

## A new shaving era

We processed a barber's edge—the keenest cutting edge known—on a safety razor blade! That's the story in few words.

Now we offer you the world's fastest shave—a velvet shave in 78 seconds from lather to towel.

We talk in terms of time, because the only way to get a quick shave is with a super-keen blade.

Old-time ways won't do it. Put your watch before you and prove it to yourself!

## Once over the face—that's all

With this new edge, you run over your face one time—only. A second is not needed.

And that's where you cut shaving time one-half. And spare your face, for dull-edged blades inure the skin.

Three men in four past 35, skin specialists tell us, look ten years older than they are, because of improper methods of shaving.

No scraping. No after-shave smart. No shaving lotions needed, this new way.

## Sharpens itself

We recommend your using our famous strop for the same reason a barber strops his razor. It keeps up the keenness. It works as a part of each razor—there if you care to use it or, if you choose, you can just insert new blades as you feel the need. Self-stropping is a patented Valet Auto Strop feature.

It helps to give you the world's fastest shave every day.

## Prove it by the clock

Pick up a Valet Auto Strop Razor at your dealer's. Then give it a whirl tomorrow. Shave with your watch before you.

Note the time—78 seconds for a velvet shave. That's our proposition. To you, it will prove a revelation.

\$1 or \$5

Valet Auto Strop comes in two styles, \$1 and \$5.

The four dollar difference is in the superlative finish of the latter. The 78-second shave, you'll find in either one you choose. Gold plated and sterling silver fitted sets—ideal for gifts—are priced up to \$25.



"Strops its own Blade." Shaves, cleans, strops without removing the blade.



3 Things  
in a shave  
you're never  
had before

**First**—a super-velvet shave riding over the face one time. No scraping.

**Second**—a quick shave—78 seconds from lather to towel. Only a super-keen blade can do it.

**Third**—a 78-second velvet shave every day. The strop keeps up the edge of the blade.



Mail This *If your dealer cannot supply you*

Solomon Safety Razor Co.  
6-4 First Avenue New York City

Enclosed is one dollar (\$1.00) for which send me one of the Model C Valet Auto Strop Razor sets complete.

Name

Street Address

City and State

# Valet Auto Strop Razor

REGISTERED U.S. PATENT OFFICE





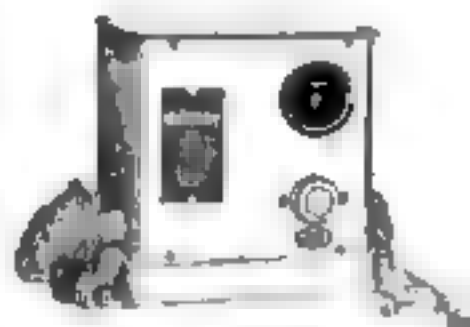




## HOMCHARGE your Radio Battery for a nickel!

Enjoyable Radio Concerts and maximum receiving range are obtained only when your battery is fully charged.

Don't be bothered with the inconvenience and expense of taking your battery to a service station every few days for recharging.



Type "R" (Portable)  
Radio Homcharger De Luxe

### RADIO HOMCHARGER DE LUXE

has been designed especially for this purpose. It charges your "A" or "B" battery over night without removing it from your living room. The Homcharger is silent and clean in operation—no hum—no trouble—no dirt—requires no watching.

Simplicity itself. Attach to any lamp socket and connect to battery. Fully automatic in operation—cannot overcharge or injure your battery.

Constructed of the best materials—moulded Bakelite Base—Jewell Ammeter—Overvoltage Silicon Steel Transformer. No castings to break—only the finest stampings used thruout.

SAFE—all parts entirely enclosed—no danger from fire—approved by Fire Insurance Underwriters everywhere. Unconditionally guaranteed—lasts a lifetime.

#### An Ornament For Your Living Room

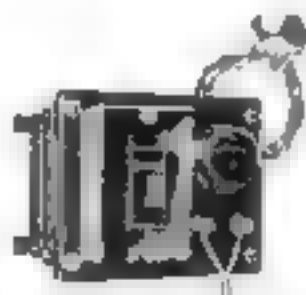
Beauty has been combined with utility in the NEW RADIO HOMCHARGER DE LUXE. The body is beautifully finished in rich Antique Mahogany—the base and fittings in a handsome dial gold. Equipped with rubber feet, it cannot mar polished surfaces. It harmonizes with the finest living room.

#### Over 50,000 HOMCHARGERS IN USE

50,000 users have heartily endorsed the HOMCHARGER. Beware of imitations when buying as there is only one HOMCHARGER. Insist on the genuine which bears our registered trade name, HOMCHARGER.

Furnished complete with attachment cord and plug, charging cable and battery cups. No extras to buy. Price at all good radio, accessory and electrical dealers \$14.50, or shipped prepaid upon receipt of purchase price, if your dealer does not carry it.

Booklet illustrating the NEW RADIO HOMCHARGER DE LUXE in actual colors is FREE for the asking. Send for your copy today.



Type "W" Homcharger for  
Wall Mounting  
Over 50,000 in Use

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Los Angeles - Baltimore - Minneapolis - Kansas City - St. Louis - Atlanta.



# Now Ready!

## The DICTOGRAPH Radio Loud Speaker for the Home

**T**HE Radio public has been waiting for the Dictograph Radio Loud Speaker Perfected by Dictograph Products Corporation, the pioneer manufacturer of loud-speaking telephones, and world-famous for its sound-transmission instruments: the same supreme quality as other Dictograph products.

Years of experience have made possible this new Loud Speaker—the best in the world—and sold at a price that gives you DICTOGRAPH quality at no extra cost. The great, assured demand has made possible a reduction from the price originally announced. Instead of \$25 it is only \$20—complete with 5 ft. flexible cord.

See the Dictograph Loud Speaker at your dealer. Dealers can be supplied by local jobber—or inquire direct.



Price  
**\$20**  
Complete with  
5 ft. flexible cord

### The Standard of the World

The Dictograph Loud Speaker is beautifully constructed; the cabinet is of hardwood, ebony finished, with die cast black enameled aluminum tone arm. The horn is spun copper, highly polished, French lacquered, non-tarnishable. Completely equipped with 5 ft. flexible silk cord. For any vacuum tube receiving unit. No extra batteries required.



### DICTOGRAPH Radio HEAD SET

Ask for the Dictograph Head Set—the best Head Set in the world, regardless of price. The name Dictograph is your guarantee of supreme quality. It insures the most sensitive and accurate transmission of sound known to Radio.

**DICTOGRAPH PRODUCTS CORPORATION**  
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### HOW TO CONDUCT A RADIO CLUB

By F. E. ...

POPULAR SCIENCE MONTHLY

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### Radio Hook-Ups

By ...

POPULAR SCIENCE MONTHLY

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## Brings this 2K Size Genuine Diamond Ring

Price  
Only  
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\$1.00 brings biggest diamond ring for 4000 feet  
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ALL PLATINUM

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Send only \$2.00

It is a money order, not a check, and  
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### BETTER SHOP METHODS

### Using a Small Chuck on a Large Lathe Faceplate

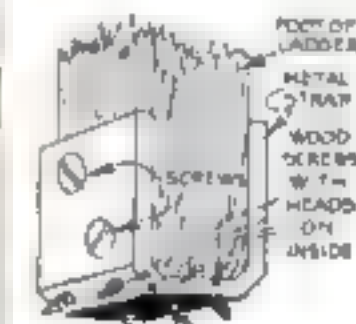
**I** HAD to machine a large number of pieces that required a chuck to hold them. To hurry the work it was desirable to use a large lathe, but I had no chuck that would fit the lathe. I took a chuck from one of the smaller lathes and centered and clamped it on the faceplate of the large lathe. The illustration shows how this was accomplished.—HARVEY MEAD.



### A Ladder that Won't Slip

**M**ANY a man has been injured by the slipping of a ladder on a smooth or oily floor. Where special shoes are not on hand for the ladders and where it is not important to protect the floors from being marred, it is a simple matter to use the method illustrated for preventing ladder accidents.

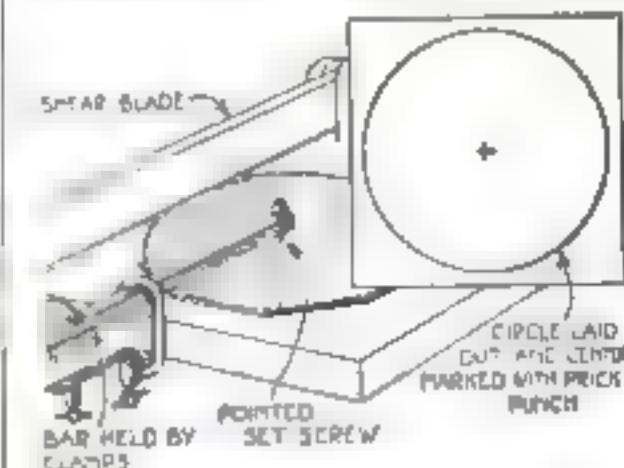
Simply drill some holes through a piece of strap iron of suitable thickness and length, and fasten with screws to the base of the ladder as shown. The number and size of screws will depend upon the size of the ladder and the kind of floor on which it is to be placed. On all but metal floors this device proves an effective and dependable safeguard.—N. G. NEAR.



Ladder shoe studded with screws

### Cutting Sheet Metal Disks with the Bench Shears

**C**IRCULAR or semicircular plates of sheet metal may be cut with a straight blade shears. If the method illustrated is used. A pointed set screw is threaded into the end of a bar and used to center the



As metal is revolved, blade tries to approximate circle

plate to be cut at a distance from the blade of the shears equal to the radius of the required circle.

The bar is clamped firmly to the bench in any convenient manner and the metal is turned while a number of roughing cuts are made. These are followed by a series of finishing short cuts, which will bring the edge to a fairly true circle.—A. L.



## BETTER SHOP METHODS

Wooden Lathe Fixture Supports  
Work for Grinding and Milling

WHEN a small lathe is equipped with grinding and milling attachments, the work must be held either between centers or, in the case of the milling attachment, sometimes in the milling spindle chuck. It is often convenient to grind or mill flat surfaces or work that cannot very well be attached to the faceplate, or held in a chuck or between centers.

To overcome this difficulty, as well as to increase the usefulness of the lathe, an auxiliary back support for the work may be made of heavy lumber and quickly attached or detached from the lathe bed. The work is screwed, bolted, or clamped directly to the back piece, as shown in the illustration, where two small cast-iron bases are screwed on so that their top surfaces can be finished ground by means of a cup wheel on the shaft of a small motor bolted to the cross slide of the lathe.

For milling, the back timber, in most cases, would have to be brought nearer the lathe bed, but the brackets can be left long



Detachable auxiliary back support

and several holes drilled so that adjustments can be made to suit the work in hand.

A timber support of this kind must be heavy and well braced, and even then is suitable only for light milling or grinding. The two brackets are made of oak planks, but they might be constructed of iron or steel bar, angle stock, or cast iron. The bottom is recessed to fit over the lathe bed. The method of clamping depends entirely upon the type of lathe. Here the bed was of the double V type and the clamps were made of two short lengths of bar iron  $\frac{3}{4}$  by  $1\frac{1}{4}$  in., with one edge filed to a 60-degree angle.

One of the pieces was bolted permanently in the lower notch of the hard wood bracket; the other acted as the tightening clamp and was loosened for removing the bracket. Strap iron diagonal braces are essential to prevent the springing of the work support and are best attached to the same bolts that hold the timber to the brackets.

In general, it is best to use a back timber the full length of the lathe bed so that long work may be handled, but extra bolt holes should be provided and the brackets set closer together to obtain extra stiffness for short pieces of work.—H. H. P.

Coarse Sand Is Best for Making  
Concrete

IN MIXING concrete for constructions that require great strength and durability, select sand that contains a large proportion of coarse particles. The greater part of the sand should be coarse enough not to pass a sieve containing 50 linear divisions to the inch.—S. M. H.

Everest  
The Highest  
Point On  
Earth

This photograph was taken at Khamba Dong, Tibet, a short distance from Everest. The figure wearing the sun helmet is General, the Honorable J. Bruce, Commander of the Expedition. Opposite, one of the members is operating the Remington Portable. Writing from Khamba Dong on April 13, 1922, General Bruce says: "The Remington Portable Typewriter is a very great success and we have it continually in use—it has gone through a pretty hard trial as we have taken it over several high passes in very bad weather."

The heroic efforts of the hardy explorers who attempted to reach the "top of the world" have won the admiration of all lovers of true sportsmanship.

The story of this attempt to conquer the "mountain of mystery" contains one of the finest tributes ever paid our product—the fact that the day-by-day record of the expedition was written on a

Remington  
Portable

Service under the frightful conditions encountered by the Mount Everest Expedition may be called the extreme test of a writing machine. Under this test, the Remington Portable has given final proof of its surpassing strength and dependability. Amid mountain cold and storm, under conditions where man could hardly live, this sturdy little typewriter daily tapped out the story of effort, hardship and supreme endurance.

The Remington is the most complete of all portable typewriters—with Standard Keyboard—just like the big machines. And it fits in a case only four inches high.

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Dept. 49 2812 Prairie Ave., Chicago, Ill.

Pins are inserted in the two end parts and engage opposite slots in the center disk. Since the accuracy of the alignment of the whole tool depends upon these pins and their slots, care should be taken in the machining of the holes and slots.

**NEW YORK WIRELESS INSTITUTE**  
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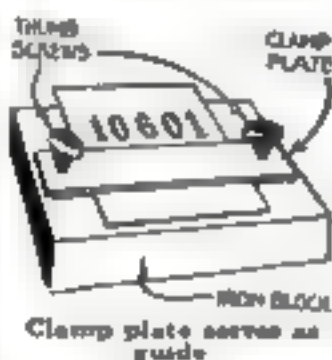
Name \_\_\_\_\_  
Street or Rural Route \_\_\_\_\_  
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Incorporated \_\_\_\_\_



## BETTER SHOP METHODS

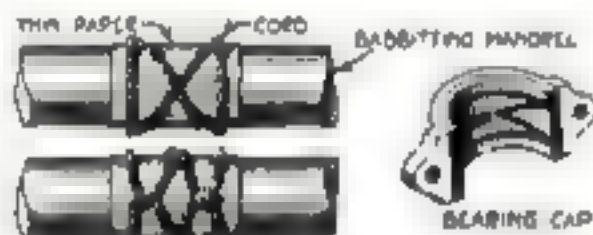
## Clamp and Gage for Numbering with Steel Stamps

WHEN serial numbers or letters have to be stamped on name plates or other work, it is often best to use a holder and gage such as is illustrated. The base, preferably an iron block, has hole at each end tapped for  $\frac{1}{8}$  in. thumb-screws. The clamp and gage plate is a short length of  $\frac{1}{2}$  by 1 in. stock drilled at each end to correspond with the thumb-screw holes. This arrangement will be appreciated by any one who has tried to stamp a straight row of figures or letters guided by the eye alone.—J. P.



## Rebabbitting Bearings Easily

ONE of the quickest and easiest expedients for rebabbitting connecting-rod or crankshaft bearings in a gas engine is wrapping the shaft with a piece of well oiled paper, tying it with a piece of twine



Cord forms core for all grooves

arranged in the same shape as the desired oil grooves, and pouring the metal. The thin paper filling affords a clearance and makes unnecessary excessive scraping; and the channels formed by the twine take the place of grooves cut by hand.—A. G.

## Repairs Made by Electroplating

THE loss of even a small fraction of an ounce of metal from some part by wear often makes it necessary to make or purchase a complete new part, meanwhile tying up the whole machine tool. In many cases, however, worn parts can be restored to their original dimensions by depositing on them electrically a film of metal—nickel is good on account of its hardness—of the requisite thickness.

The part is cleaned thoroughly and dipped into melted wax. When the film of wax has cooled, it is scraped away from the surfaces that require treatment and the part is immersed in the plating bath. As the metal is deposited very slowly, it is easy to work to very close limits; yet, if sufficient time is allowed, the deposit may attain a thickness of 1/10 in. or more.

If the operation is properly carried out, the nickel adheres to its foundation very tenaciously and is quite continuous and of even thickness throughout. In this way expensive and heavy items, such as crankshafts, cylinders, and pistons, can be made serviceable again at a cost far smaller than that of a new part. At the other end of the scale, very slight wear in delicate machinery, in which close adjustment is essential may be put right by a metal film of the exact thickness required. F. H. SWEET

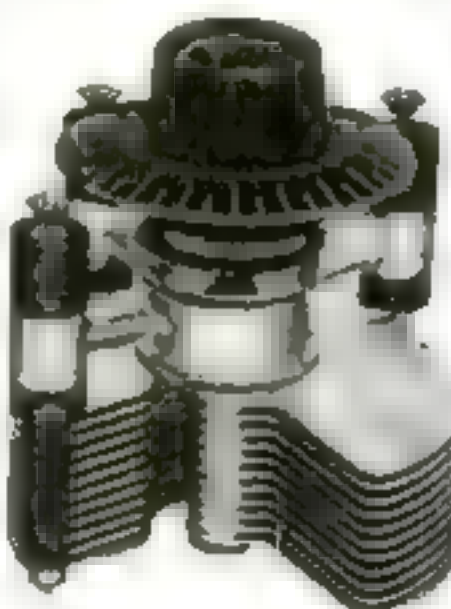
# What's in the Name

## Cotoco

TRADE MARK REG. U. S. PAT. OFF.

### Radio Supplies Made Right for Superior Results

The first Cotoco products were Honeycomb Coils. We still make them, second to none in quality. Designed by an organization of Radio Experts, and made to conform to highest standards of electrical and mechanical excellence, Cotoco Products are Right. Buy by the name Cotoco and you'll never change. The reason is in-built excellence.



#### Cotoco Variable Air Condenser

Minimum electrical losses, smooth control, sharp tuning and rugged mechanical construction are the features that make this condenser the one for your set.

You can see it's Better

#### Cotoco Amplifying Transformer for Audio Frequency



You will appreciate this transformer. Designed to give greatest amplification with little if any distortion. Splendidly finished for lasting service.

### Cotoco Users are Doing Wonders with Loop Aerials

Ample range, superior selectivity, and astonishing reduction in static and all other distortions are secured with loop aerials by the use of the Cotoco method of radio frequency amplification. You'll not be satisfied until you are getting such improved results.



#### Cotoco Amplifying Transformer for Radio Frequency

Here are two of the compact transformers for Radio Frequency Amplification that have made loop aerials available to all, and thus with practical elimination of "static." If you want your set to serve you well, static or no static, loop aerial or ordinary, here's the solution. A tapped transformer. Connection Diagram for two or three stages of amplification in every package, or write us for it—FREE

#### Cotoco Products are Sold by Good Dealers

everywhere, but there's a chance your dealer may not carry the line. Send us his name and address and we will forward

#### Free Connection Diagram

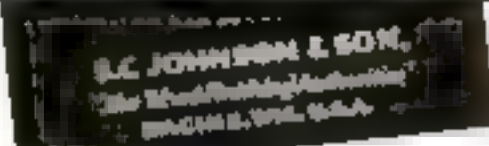
for Loop Aerial set and see that gets the Cotoco products you want

**COTO-COIL COMPANY**  
87 Willard Ave., Providence, R. I.





## FREE-This Book on Home Beautifying



THIS book tells how to finish wood in artistic stained and enameled effects. Gives practical suggestions on making your home artistic, cheery and inviting. Tells just what materials to use and how to apply them. Includes color card—gives covering capacities, etc. Use coupon below

## Johnson's Wood Dye

With Johnson's Wood Dye inexpensive soft woods, such as pine, cypress, fir, etc., may be finished so they are as beautiful and artistic as hardwood. Johnson's Wood Dye is very easy to apply—it goes on easily and quickly, without a lap or a streak. It penetrates deeply, bringing out the beauty of the grain without raising it—dries in 4 hours and does not rub off or smudge.

Full instructions for finishing all wood—old or new, soft or hard are given in the booklet.



S. C. JOHNSON & SON, Dept. PS 10, Racine, Wis. (Canadian Factory—Brantford)

Please send me free and postpaid your Free Book on Home Beautifying and Wood Finishing.

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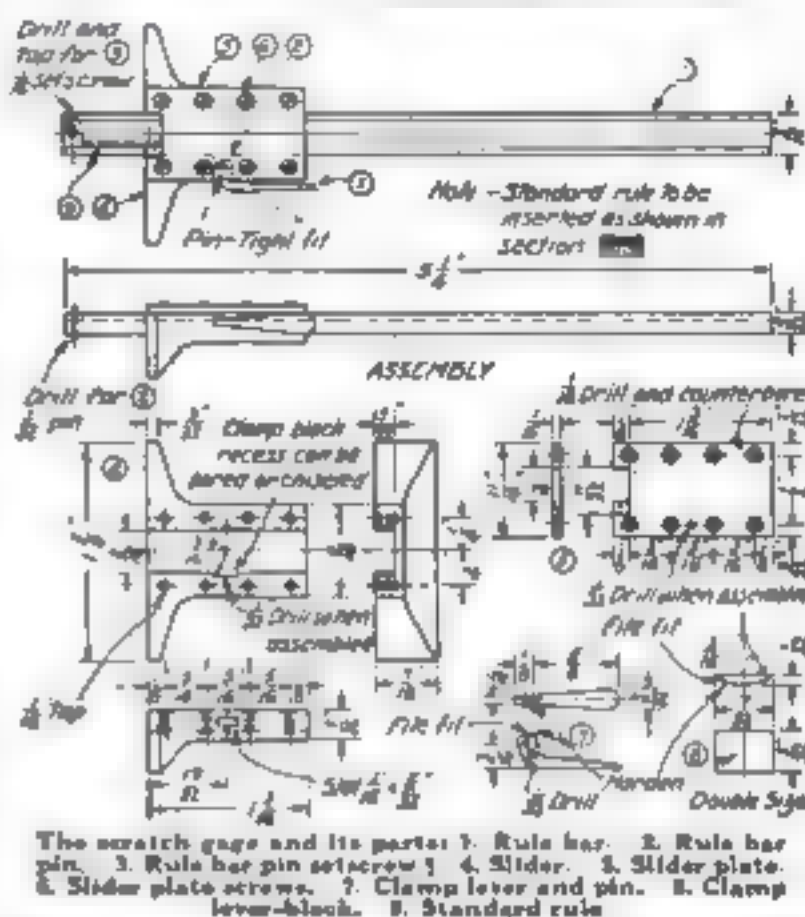
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CITY & STATE

### BETTER SHOP METHODS

## Four Useful Tools for the Machinist

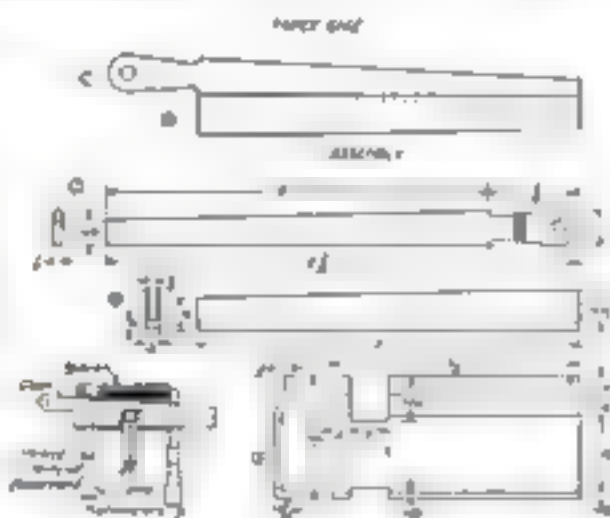
(Continued from page 76)



viding beads, and drill chucks. In use the gage is forced into the taper and the two parts being a snug fit conform with a sufficient degree of accuracy to the taper being measured. To complete the measurement the gage is placed in a spacer, as shown, so that measurements can be made with a micrometer. Two of these spacers can be made, one as shown and another shorter one to give the taper for one inch.

The scratch gage is for laying out work quickly without the use of a height or surface gage, when the accuracy required is not so great as to make the use of those tools imperative. The sliding piece and its top plate are made of mild tool steel. A standard 4 or 6 in. narrow scale with either 1/64-in. or 1/32-in. graduations is set in the bar flush with the top.

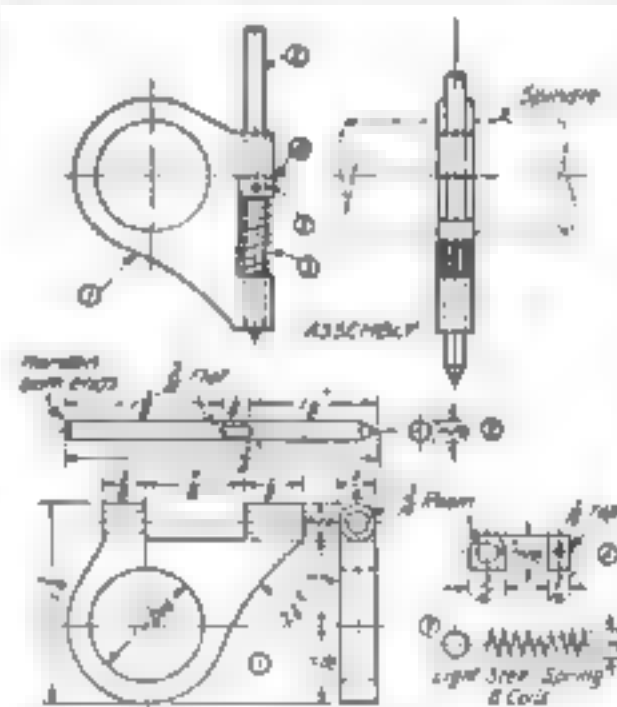
By actual trial the cam lever was found to be more satisfactory than a set screw, for tightening slider in position on bar. It is let into the side of the slider and bears on a hardened, crescent-shaped shoe. The scratch point is a piece of drill rod fastened with a screw in the side of the bar and located so that when the line on the slider plate is set at zero, the point is even with the working surface of the slider. The point should be sharpened with an oil stone.



Illustrated at left is the taper gage, which has only 3 parts: 1. Inner bar. 2. Outer bar. 3. Spacer. It can be made in other sizes. The method of using it is shown in

The cam lever is hardened and a slight pressure locks it. The bar should be a good sliding fit in the slider body.

The eccentric boring chuck and the taper gage were designed and made by Mr. Roberts; the milling machine center punch and the scratch gage by Mr. Frank Killam.



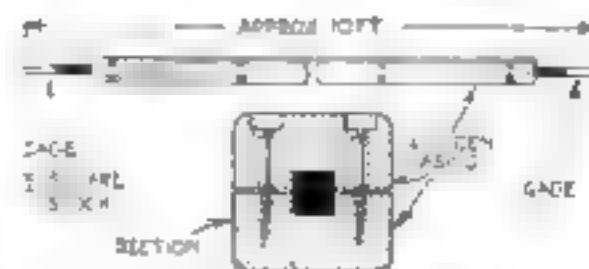
The small detail. At the right is shown the milling machine punch. 1. Holder. 2. Punch. 3. Spring. 4. Spring Retainer. 5. Spring Retainer screw.

## Wooden Casing Stiffens Long Gage

IN THE construction of some large castings it was necessary to use a gage to test a circular bore of approximately 10 ft. to determine if it deviated from a true circle.

A gage 10 ft. long would have been hard to handle and quite expensive if made entirely of metal. Instead, 1 1/2-in. square bar stock was used, stiffened with a split wooden casing about 2 in. in cross section, as shown in the accompanying diagram.

This made a very straight and stiff gage, light enough to be lifted about by hand and



Inexpensive method of making long gages accurate to the thousandth part of an inch. It was also inexpensive to make.—R. G.



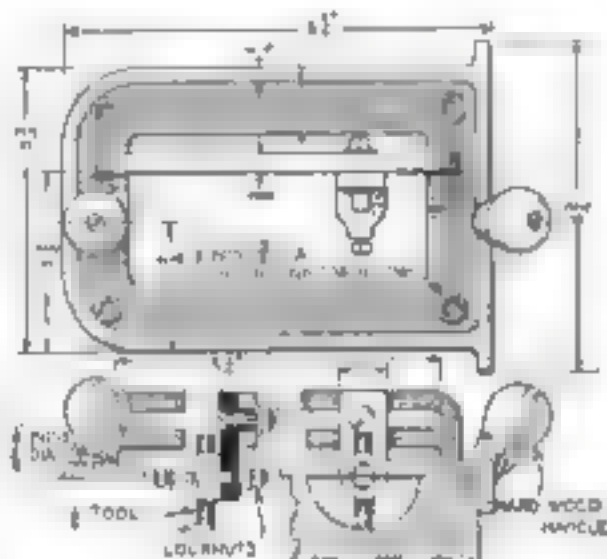
## BETTER SHOP METHODS

## Core-Box Plane and Router for the Pattern Shop

By Henry S. Laraby

THIS core-box plane is an improvement on the old-fashioned right-angle type and has the additional advantage that it can be used as a router.

The frame should be made of cast iron or aluminum. With three knives of different lengths, any size of core-box from 1 in. to 5 1/4 in. can be worked out. Before the plane is used, the work is usually roughed out to within 1/16 in. of the finished size by means of a circular saw or gouges. A cutter



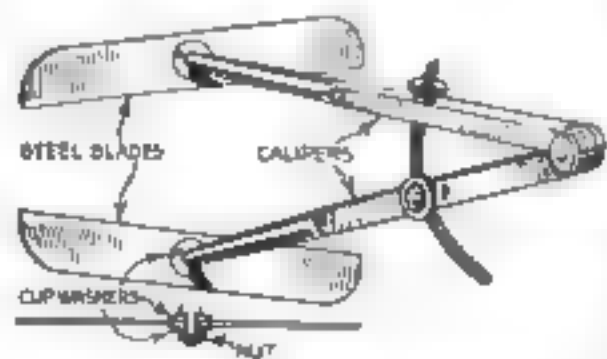
Handles many varieties of recessed planing

of the proper length is then fastened in the plane and it is run over the work, the knife swinging to the set radius. The frame provides a very good bearing and guide.

All kinds of forms are possible if the necessary knives are used. The plane can be used on irregularly shaped work by screwing strips of wood to the side of the work to guide the plane in following the desired shape. To my mind this is one of the handiest tools in the patternmaker's kit.

## Axles Machined with Aid of Tapered Calipers

IN MACHINING the end tapers of automobile rear axle shafts, I have found it difficult to obtain a taper measuring instrument that could be used close up to the tailstock or chuck, while the work was still



Can be adjusted for taper and thickness

in the lathe. So I devised this taper measuring caliper, which fully meets the requirements. The blades are held between two cup washers and tightened with a nut, they can, therefore, be adjusted to any desired taper.—D. E. CRABB.

"THE VALUE OF MONEY  
IS MEASURED BY THE  
PERMANENCY OF  
WHAT IT BUYS."

John D. Rockefeller



Trade Mark  
**Cypress**  
"The Wood Eternal"

## Why Not Have a "Glory Room"?

"That is the inviting and inspiring term which a famous publisher applied to his own Cypress Sun-parlor. The same idea begets a hunger for a Cypress Sleeping Porch. It is not at all necessary to wait until we build a new house. Why not 'tack one onto our present home'? It is always possible—and always a fine investment, entirely aside from the delight of using it. That very helpful, foresighted, broadminded and kindly-intentioned group of men known as the Cypress Association have employed some of the best talent in the country to provide thoroughly practical—really usable—as well as highly artistic, plans for the free use of those who really care. Of course, they hope to thereby broaden still further the wide preference for Cypress, 'the Wood Eternal' for all non-rot applications, but that is only natural and does not detract from the great and lasting benefit to the public due to 'an educated insistence on the best wood for the given purpose'".—J. B. C.

Vol. 35 is the Sun Parlor and Balcony Book. 48 pages. 32 pictures. 1 "For Health," a special supplement. 7 working plans with full specifications. FREE on request. Write. (Also ask for Vol. 43, a surprise book.)

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Factory Branches  
All Over The World



## The Home Workshop

(Continued from page 75)

## Craft Work Designs Made with Shadows

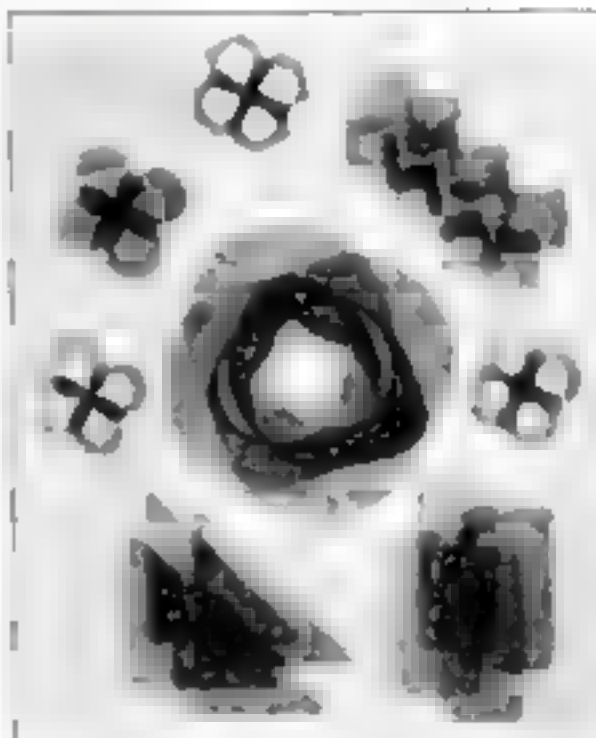
EVERY home worker who has ever attempted to do artistic handwork and is interested in the decorative crafts, finds continual difficulty in obtaining good designs for use as ornaments. This is equally true in regard to stencil ornaments for woodwork, designs for tooled leather book covers, patterns for textiles, or ornamental units and borders for handmade jewelry, hammered brass and copper work, wood carving and embroidery.

To originate really good designs requires much time, energy, and innumerable experiments on the part of even a trained designer. On the other hand, to take ready-made designs from books and commercial stencils is never

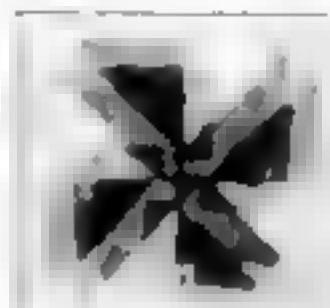
By E. Bade

If any sort of a regular or symmetrical object, even so simple a one as a cube, a washer, or a coin, is placed upon the glass and the lamp is turned on, a shadow design will be thrown upon the sheet of paper placed below the glass. This is because the light reflected by each of the four mirrors casts an individual shadow, each overlapping the others.

Many of the designs obtained in this way are most wonderful, not only in shape but in tone relation. The overlapping lights and darks make several shadows of gray that are harmoniously related to each other and invariably in proportions that are delicately balanced and pleasing to the eye. All the de-



The central figure was formed with 2 washers of different sizes; a rectangle, triangle, hexagon nut and similar simple objects provided the other patterns.



Made with 4 triangular stone blocks placed in the form of an open Maltese cross.

satisfactory to the true craftsman, because many of the designs are hackneyed, commonplace, and inappropriate.

This problem may be solved by a uniquely

signer needs to do is to copy the design, either freehand, by tracing, or by exposing a sheet of photographic printing paper under the glass plate. The design can be modi-

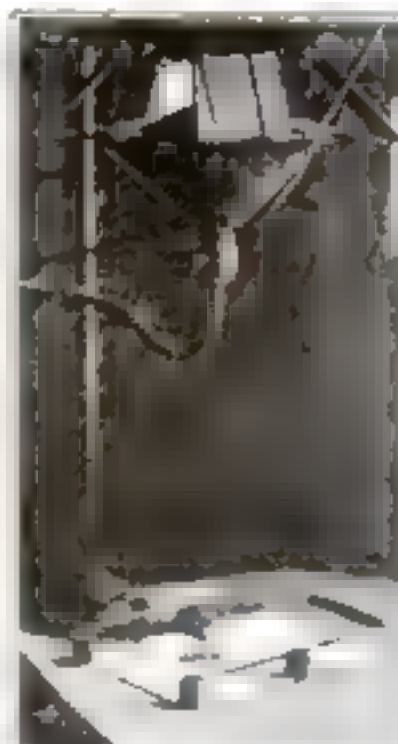


Four pointed blocks, each with one side rounded, arranged in open formation.

simple method that enables the craftsman to originate innumerable designs to serve the purposes of whatever work he has in hand.

The apparatus necessary makes use of shadows cast by an arrangement of mirrors in conjunction with an electric or other light. Four mirrors of equal size are provided with brackets made from strips of brass or heavy wire, as illustrated, and arranged about an inverted lampshade, so that they are spaced at equal distances and angles from the light. The brackets should be bent so as to throw the light downward on one spot immediately below the lamp.

The apparatus is completed by a pane of glass blocked up so that it rests an inch or two above the table.



The shadow designer with its 4 mirrors arranged symmetrically about an inverted lampshade so that the light is thrown downward upon a ruled piece of glass that carries the object provided for casting the quadruplicate shadows.

fied to suit the place in which it is to be used. If in color, substitute colors for the grays in the toned areas in the shadow design.

Other arrangements of mirrors can be used, or even the direct light of a 2- or 4-bulb fixture, used without mirrors. Raising or lowering the pane of glass in relation to the table will also be found to vary a design materially without any other alterations. Objects for casting shadows may be of the simplest variety—buttons, paper clips, regularly placed and spaced matches, wheels, gears, toy trucks, and other odds and ends.

With this interesting, easy, and practical method of obtaining good working designs, no home worker need ever be at a loss for decorative motives at once artistic and original.



## THE HOME WORKSHOP

## WIN A PRIZE FOR YOUR BEST IDEA

**W**HENEVER you make something that is particularly novel and useful, or discover some new and valuable way to use your tools to better advantage, think of the Home Workshop Department. It exists primarily to publish just such ideas and not only pays well for them, but awards each month a first prize of \$15 and a second prize of \$10 for the best suggestions sent in by readers and contributors.

Your letter or manuscript need not be long; in fact, the shorter it is, the better, provided it explains the idea clearly and contains sufficient data in the way of description, sketches or photographs for purposes of preparing the illustrations.

The prize-winners for October are:

**FIRST PRIZE, \$15: Herbert A. Mincher, Youngstown, Ohio,** "Unique Floor Lamp with Caned Pedestal Can Be Made with Few Tools" (see page 75).

**SECOND PRIZE, \$10: Gladstone Califf, Richland, Ia.,** "Tool Grinder Provides Power for Sandpapering Machine" (see page 93)

## Make a Radio Set

**N**OW is the time to make a radio receiving set, to prepare for fall broadcasting.

The most popular set is the vacuum tube detector set using the regenerative circuit, with two stages of audio frequency amplification. Full details for making this set can be obtained by sending 25 cents to the Blueprint Editor for Home Workshop Blueprint No. 6. It should be noted that the set can be made up first as a single tube receiver and the amplifying steps omitted or added later, if preferred.

Many letters have been received from our readers, telling of success in making the blueprint set.

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5.	Kitchen Cabinet	25c	<input type="checkbox"/>
6.	V T Radio Receiving Set	25c	<input type="checkbox"/>
7.	Shaving Cabinet	25c	<input type="checkbox"/>
8.	Arbor with Gale and Seats	25c	<input type="checkbox"/>
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10.	Bench and Tilt-Top Table	25c	<input type="checkbox"/>
11.	Electric Washing Machine	25c	<input type="checkbox"/>

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Street

City and State



## Teeth You Envy

Are brushed in this new way

Millions of people daily now combat the film on teeth. This method is fast spreading all the world over, largely by dental advice.

You see the results in every circle. Teeth once dingy now glisten as they should. Teeth once concealed now show in smiles.

This is to offer a ten-day test to prove the benefits to you.

## That cloudy film

A dingy film accumulates on teeth. When fresh it is viscous—you can feel it. Film clings to teeth, gets between the teeth and stays. It forms the basis of cloudy coats.

Film is what discolors—not the teeth. Tartar is based on film. Film holds food substance which ferments and forms acid. It holds the acid in contact with the teeth to cause decay.

Millions of germs breed in it. They, with tartar, are the chief cause of pyorrhea. Thus most tooth troubles are now traced to film, and very few escape them.

## Must be combated

Film has formed a great tooth problem. No ordinary tooth paste can ef-

fectively combat it. So dental science has for years sought ways to fight this film.

Two ways have now been found. Able authorities have proved them by many careful tests. A new tooth paste has been perfected, to comply with modern requirements. And these two film combatants are embodied in it.

This tooth paste is Pepsodent, now employed by forty races, largely by dental advice.

## Other tooth enemies

Starch is another tooth enemy. It gums the teeth, gets between the teeth, and often ferments and forms acid.

Nature puts a starch digestant in the saliva to digest those starch deposits, but with modern diet it is often too weak.

Pepsodent multiplies that starch digestant with every application. It also multiplies the alkalinity of the saliva. That is Nature's neutralizer for acids which cause decay.

Thus Pepsodent brings effects which modern authorities desire. They are bringing to millions a new dental era. Now we ask you to watch those effects for a few days and learn what they mean to you.

The facts are most important to you. Cut out the coupon now.

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Endorsed by modern authorities and now advised by leading dentists nearly all the world over. All druggists supply the large tubes.

10-Day Tube Free

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With Three Mounting Bases  
The three mounting bases are made of the same material as the gauge. The 407 provides dimensions of 1 1/2" depth of travel. Dimensions are 1 1/2" x 1 1/2" x 1 1/2".

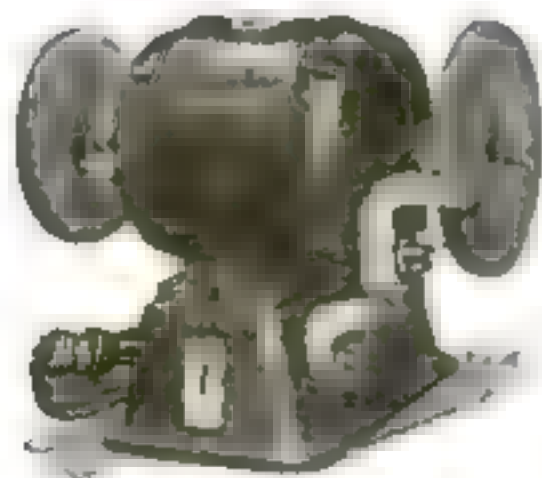
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Wire wheel for tire repair work \$1.50 extra.

Motor alone for running washing machines, ventilating fans, cream separators—all kinds of machines.

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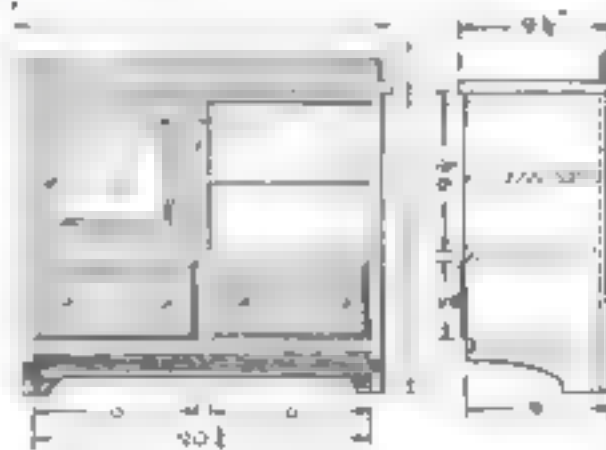
### THE HOME WORKSHOP

## Constructing an Enameled Wall Cabinet for the Small Bathroom

By Clifford A. Butterworth

FOR the small bathroom, where there is no room for built-in drawers or a cupboard, this wall cabinet will prove convenient. It has a closed compartment for medicines, two shelves, and two good sized drawers in which towels may be kept.

Made mainly of 3/4 or 1/2 in. whitewood, it is glued together, with a few nails for

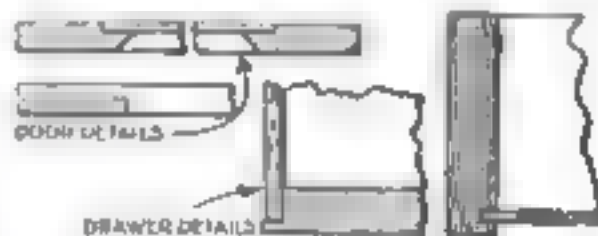


Front and end views with suggested dimensions

reinforcement where necessary. The finish is white enamel.

The back is cut 21 by 20 1/2 in., and projects 1 1/2 in. above the top. The top projects 1/4 in. at the front and sides. A 3/4-in. strip is fitted over the door and shelf compartment. The door frame is made of 3/4-in. stock 2 in. wide. The corner joints and section through the frame is shown in the door details. Either a mirror or a thin wooden panel can be used.

The drawer fronts are of 3/4-in. stock, the sides of 1/2 in. The sides are fastened to the front with glue and nails, the joint being made as in the left-hand drawer detail. The bottom is 1/4-in. stock and fits into grooves cut in the sides as shown. The drawer



How the door and drawers are constructed

fronts are beveled off 3/16 in., and the drawers are fitted so that they project that amount when closed, as indicated in the side view. The door and drawers are fitted with knobs. The open shelf is made of 1/2-in. stock and is either dadoed into the end and partition or supported by small cleats. A shelf also may be fitted in the medicine compartment, if desired.

When the cabinet is completed, the nails are set and it is given a coat of flat white paint. The holes are then puttied, and it is given two coats of enamel.

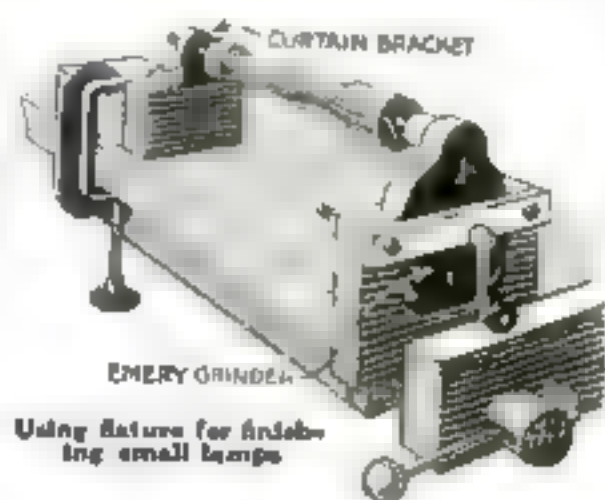
A GARAGE that specializes in polishing cars makes its own body polish. This produces a fine luster that does not collect dust or show rain streaks. Although not a cheap polish, it is less costly than the usual polishes sold in cans or bottles. It consists of 1/4 gal. turpentine, 3/4 pt. paraffin oil, 2 oz. oil of citronella, and 1 oz. cedar oil. These are thoroughly mixed, applied with a soft cloth, and rubbed lightly and briskly until dry—T. S. F.



## THE HOME WORKSHOP

## Tool Grinder Provides Power for Sandpapering Machine

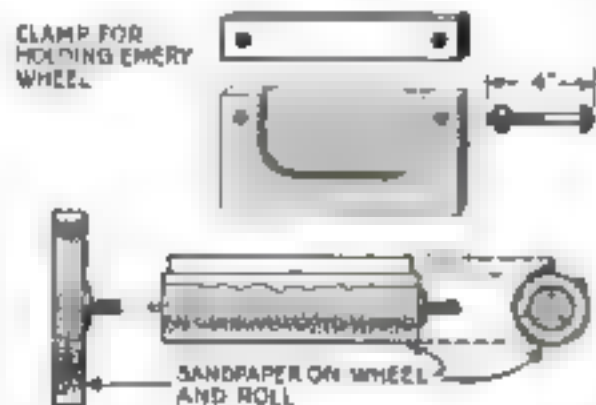
FOR finishing and polishing round pieces of wood, such as boudoir lamp bases and shafts, a sandpapering machine can quickly be rigged up with the aid of an ordinary tool grinder. The grinder is clamped in a wooden holder by means of a strip of wood and two bolts, as shown, and this holder is held in the vise. The spindle, from which the emery wheel is removed, forms the live center. A dead center is made with an L-shaped block of wood and



a windowshade bracket, the whole being clamped to the bench with a C-clamp.

Small turned pieces can be sandpapered, finished, and polished by using the device as a lathe. In addition, a circular disk about 6 in. in diameter can be covered with sandpaper and attached to the live center to serve as a disk sander. In the same way a drum can be used between centers.

This fixture was used in making several electric reading lamps from old table legs. When cut to the right size and the old varnish removed, each shaft was mounted in the machine and stained. Then a French polish was applied. This was done by making a pad of soft cloth, free from lint and dipping the inside center of the cloth in shellac. Another piece of cloth was placed over it and twisted, so that by twisting the outside piece a little harder from time to time, the shellac on the inner pad was squeezed out. The pad was dipped in linseed oil occasionally to prevent it from sticking. The machine was first speeded up and then the pad was applied until the wood would absorb no more



Details of emery wheel clamp and sander

shellac. After one coat had thoroughly dried (in twelve hours or more), the operation was repeated until at least three coats had been applied.

The bases were cut on a scroll saw and then attached to the live center by means of a screw, and sandpapered. In this way they were made almost as true as if they had been turned in a lathe. The completed product looked like a lamp bought in the stores. — GLADSTONE CALIFF

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## 1500 GOOD TOOLS



Mr. PUNCH:  
Automatic Drill No. 123  
with 8 Drill Points.  
Size 1 1/4 in. to 1 1/2 in.  
Price, \$2.68

### "Clean as a Whistle!"

Mr. Punch says:

"I'm an automatic drill. I just bore and bite my way through anything and everything. And I leave a good clean hole, too—a hole as clean as a whistle!"

Of the boring of holes there is no end—everybody sooner or later feels the need of putting a hole into something or other. In the house, in the garage, in the laundry, in the kitchen—there's al-

ways something that requires a good hole for a screw or a hanger, a lock or a bolt.

With Mr. Punch, the Goodell-Pratt Automatic Drill, you just look in the handle and select any one of eight different sizes of drill points. You pick out the right size, fit the point into the "chuck," and Mr. Punch, the Automatic Drill, does the rest—the hole is made in a minute.

Pushes right through plaster without a crack or a chip

Through the hardest wood without a split. Through soft lumber and no mashing, crumbling, or belling up on the point of the drill.

every man a repair man. Any amateur handyman can use it. Butlers, chauffeurs, laundrymen, farmers, newlyweds—everybody

with a head and two good hands can use this drill.

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GOODELL-PRATT COMPANY

*Toolsmiths*

Greenfield, Mass., U. S. A.





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with the  
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9 in. swing  
2 1/2 ft. bed

**PRICE.**  
**\$225**

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## THE HOME WORKSHOP

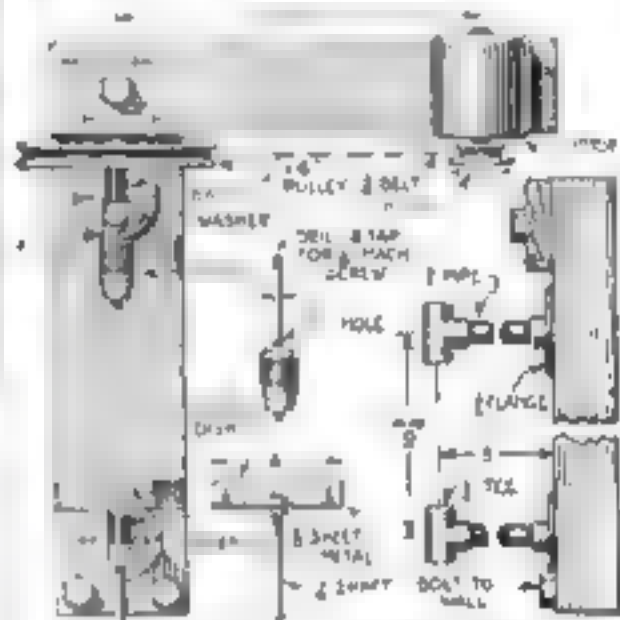
### Building a Drill Press for the Home Workshop

By H. L. Johnson

TO MAKE a drill press that will pay for itself in the time it saves in the home workshop is not at all difficult. The materials needed are as follows:

- 1 1/2-in. drill chuck with a 1/2-in. shaft 1 1/2 in. long, drilled and tapped on end
- 2 1/2-in. pipe tees
- 2 1/2-in. floor flanges
- 2 4-in. lengths of 1/2-in. pipe threaded both ends
- 1 12-in. piece of 1/2-in. shafting threaded on one end, with two nuts to fit
- 1 disk of 1/2 in. brass or steel 4 in. in diameter
- 1 sewing machine motor or motor about that size
- 12 1/2-in. wood screws
- 4 1/2-in. wood screws
- 3 ft. of 1/2 in. or 3/16 in. round belting
- 1 18-in. piece of 2 in. by 4 in. oak or pine
- 1 piece of 14 in. by 2 1/2 in. by 1/4 in. oak or pine
- 1 piece of 12 in. by 6 in. by 1/2 in. oak or pine
- 1 1 in. by 1/2 in. washer with a 1/4-in. hole
- Some babbitt metal and two 1 in. by 1/2-in. washers with 1/4-in. holes

The frame is built by screwing together the 12- and 14-in. lengths of oak or pine at right angles to each other. The pipe tees are then babbitted by coating the 1/2-in. shaft smoothly with white lead centering it in the tees, closing the ends



Front view of the completed drill press and details of pipe bearings, table, and chuck

with cardboard washers on the shaft reinforced with putty, and pouring hot babbitt in through the third opening. After the babbitt has cooled, the shaft may be twisted out. The floor flanges, pipe and tees are next assembled as shown. It is easier to line them up properly if the shafting is first run through the tees.

From the remaining piece of wood cut or turn three disks 6 in., 4 in., and 1 1/2 in. diameter. The 6-in. disk is grooved for a 1/2-in. round belt, and a 1/2-in. hole is drilled through the center. The 1 1/2-in. disk is turned down to 1 in. in diameter for two thirds of its width, and also grooved for the belt. If a lathe is not available, this disk can be made in two parts.

The 4-in. disk is bored with a 1/2-in. bit to the depth of 1/2 in. Then drill a 1/4-in. hole in the center of the 4-in. brass disk, and four other countersunk holes for 1/2-in. wood screws. Mount this disk on the threaded end of the 1/2-in. shaft, which should first be run through lower tee. Then fasten the wooden disk to the brass disk.

The 1/2-in. drill chuck, which can be purchased at a hardware store, should have a hole drilled through its shaft 1/16 in. above the chuck head when all the jaws are closed. The 1-in. washer is then slipped on the shaft and rests on a pin or

(Continued on page 95)



## THE HOME WORKSHOP

## Building a Drill Press

(Continued from page 94)

nailed driven through the hole. This is done to take care of the upward thrust of the chuck in drilling. The chuck shaft is then passed through the upper tee and the large pulley with a washer countersunk on the top and bottom is fastened to the shaft with a  $\frac{1}{8}$ -in. round-headed machine screw. A small hole is then drilled in the outer end of the slot in screw head and down through the top washer. In this hole a small finishing nail is driven to prevent the screw from turning.

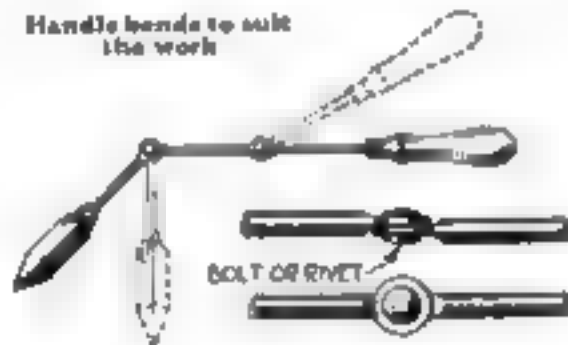
In operation the work is brought up against the drill by raising the lower disk.

## Soldering Copper with Flexible Handle for Awkward Places

**BY INSERTING** one or two joints in the ordinary soldering copper handle, it can be improved for use on parts that are awkward to reach.

Cut the handle in two and flatten out the ends by either beating and hammering flat

Handle bends to suit the work



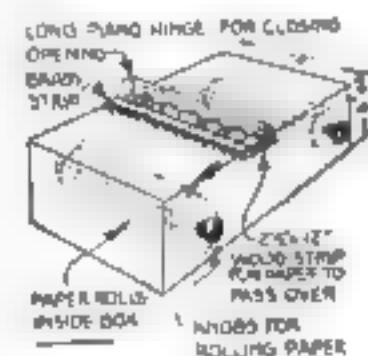
or else sawing out roughly to shape and flattening cold. Make a third section from iron rod and flatten both its ends. Drill all the flats with  $\frac{1}{8}$ -in. holes and rivet them together with steel rivets or join them with small stove bolts. See that the joints are very stiff so that they will stay set in any position. L. B. ROBERTS.

## A Continuous Record Box

**A NEAT** record-keeping device, useful for many purposes where daily and hourly records are to be checked, was made by fitting a rectangular box with two spindles, upon which a roll of paper was held. The paper was fed through a slot in the center and over a  $2\frac{1}{2}$  in. by 12 in. strip of wood to the opposite roller. The slot was

1 in. wide, the wood strip over which the paper was stretched forming a backing.

A thin brass strip was fitted and screwed on one side of the slot and a piano hinge on the other. Divisions marking hours and half

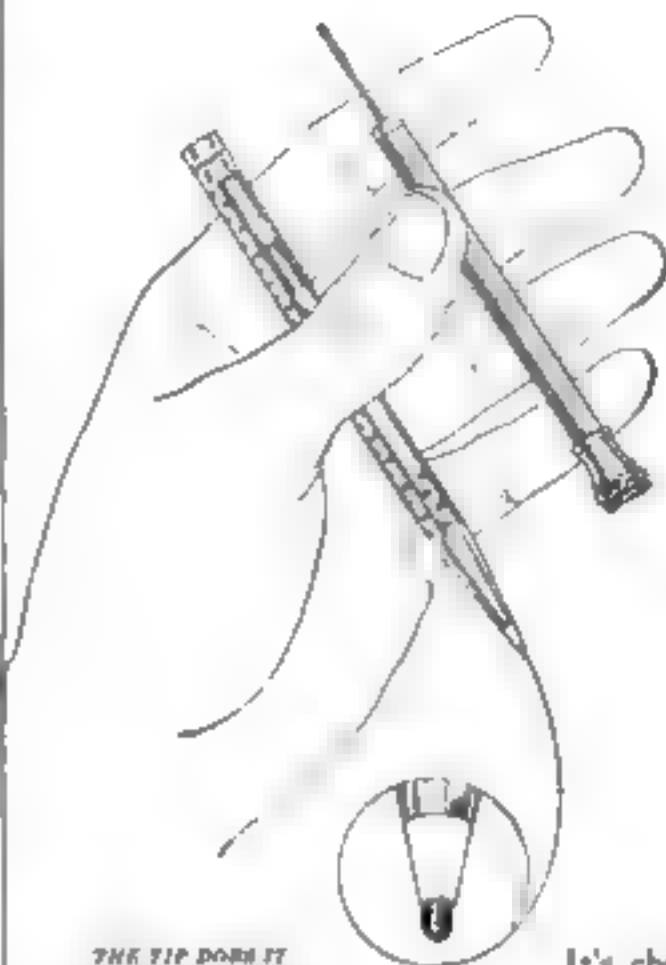


For preserving records in serial order

hours when the records were to be entered were stamped on the brass piece to keep the spacing of the record uniform.

The device was used in a power plant to record amperage and was also a check against the automatic recorder to show the engineer that his assistant was watching loads and switchboard requirements. —T. H.

## What's inside an Eversharp?



## THE TIP DOES IT

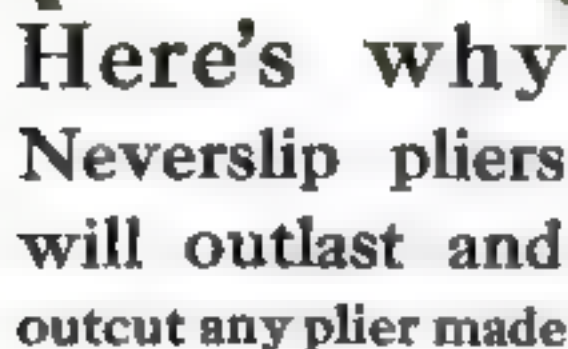
It cuts hardening gloves in the lead. There is no lead from turning. You can see from what a big world of good does this tip.

It's chock-full of the ability to write—and keep on writing. You know that. But, mechanically speaking, EVERSHARP is a perfect marvel of efficient compactness.



For only 10¢ you can have the Ever Sharp Leads. They are the best in the world. 1. 1/2 in. Ball 2. 1/2 in. Ball 3. 1/2 in. Ball 4. 1/2 in. Ball 5. 1/2 in. Ball 6. 1/2 in. Ball 7. 1/2 in. Ball 8. 1/2 in. Ball 9. 1/2 in. Ball 10. 1/2 in. Ball 11. 1/2 in. Ball 12. 1/2 in. Ball 13. 1/2 in. Ball 14. 1/2 in. Ball 15. 1/2 in. Ball 16. 1/2 in. Ball 17. 1/2 in. Ball 18. 1/2 in. Ball 19. 1/2 in. Ball 20. 1/2 in. Ball 21. 1/2 in. Ball 22. 1/2 in. Ball 23. 1/2 in. Ball 24. 1/2 in. Ball 25. 1/2 in. Ball 26. 1/2 in. Ball 27. 1/2 in. Ball 28. 1/2 in. Ball 29. 1/2 in. Ball 30. 1/2 in. Ball 31. 1/2 in. Ball 32. 1/2 in. Ball 33. 1/2 in. Ball 34. 1/2 in. Ball 35. 1/2 in. Ball 36. 1/2 in. Ball 37. 1/2 in. Ball 38. 1/2 in. Ball 39. 1/2 in. Ball 40. 1/2 in. Ball 41. 1/2 in. Ball 42. 1/2 in. Ball 43. 1/2 in. Ball 44. 1/2 in. Ball 45. 1/2 in. Ball 46. 1/2 in. Ball 47. 1/2 in. Ball 48. 1/2 in. Ball 49. 1/2 in. Ball 50. 1/2 in. Ball 51. 1/2 in. Ball 52. 1/2 in. Ball 53. 1/2 in. Ball 54. 1/2 in. 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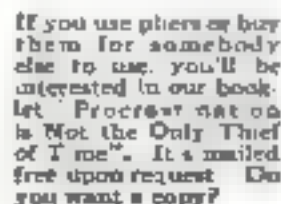


It stands to reason that when the cutting blades are made separately like Nevrelips—better steel can be used.

But the big point about NeverShip Pliers is their renewable cutting blades. Should these cutting blades become accidentally damaged they can be replaced in a jiffy with a brand new pair—just like a safety razor.

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New Brunswick      New Jersey

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### Mirror Aids in Setting the Camera for Copying

**I**N ORDER to avoid distortion when making a photographic copy of a picture or record, it is necessary that the line of sight or axis of the camera be perpendicular to the plane of the picture to be copied. A photographer who does much of this kind of work has a special stand upon which he can set up his camera and picture; but for those of us who seldom do copying work, such a stand is too expensive to buy and



Tack the picture to be copied flat against a vertical wall or lay it on the floor or a table. Set the camera as nearly opposite the center of the picture as can be done by guess. Lay a small flat mirror face up on the middle of the picture; then focus the camera on the mirror.

After removing the mirror and focusing the camera on the picture, everything is set for successful copying — P. W.

**T**O ADAPT a screwdriver for exerting great force on tightly wedged screws, bore a hole in the center of the blade and insert a steel rod, which will serve as a lever.

double-end blade. If the socket in the handle is large enough to hold the larger end of the driver, the smaller end may also be inserted.—W. J. T.

*Popular Science Monthly*  
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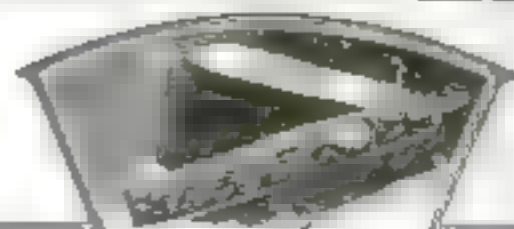
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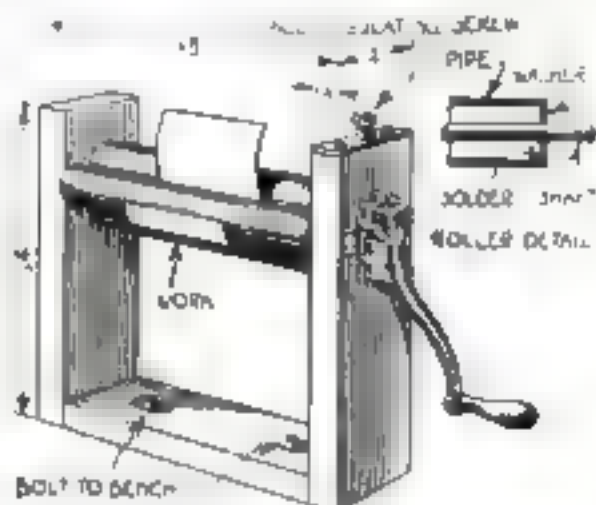




## THE HOME WORKSHOP

## Old Clothes-Wringer Converted into Bending Machine

WITH the gears, handles, and roller axles of an old clothes-wringer, three 1½-in. galvanized pipes, and a few bolts, I made a sheet metal bending machine for



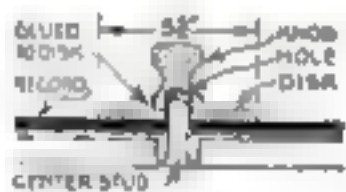
For shaping sheet metal into cylindrical forms without a hammer

my home workshop. With it I can round tin into cylindrical shapes without a hammer. The drawing shows clearly the details of the construction.—CARL BONAVITA.

## Protecting Phonograph Records

IF YOUR phonograph and records are not provided with one of the patented devices to prevent the damage that is often caused by not stopping the machine promptly at the end of a record, you can make one yourself in a few minutes' time at little or no cost.

From an old record, a piece of sheet metal, or any reasonably hard smooth-grained material 1/16 to 1/8 in. thick, cut a true circle 8½ in. in diameter and drill a hole in the center just large enough to slip easily over the turntable spindle. Round off the edge of the disk with emery cloth.



Disk stops handle from damaging record

The disk is placed on top of the record being played, so that if the needle leaves the end of the groove and starts on its destructive journey, the side of the needle strikes the smooth rounded edge of the disk before it reaches the paper label and the machine can run indefinitely without danger of injury to mechanism or record.

A small knob may be fastened to the center for greater convenience in lifting off the disk.—GLEN McWILLIAMS.

## What to Do when Your Last Hacksaw Breaks

WHILE cutting off the end of a projecting bolt, a service station mechanic buckled the blade of his hacksaw and snapped it off about 2 in. from one end. While he went for a hammer and chisel to finish the job, the foreman picked up the broken blade, held it in the flame of a blowtorch and, while it was still warm, drilled a hole through it with a hand drill. He then replaced it in the adjustable saw frame and had the saw ready for finishing the job by the time the mechanic returned.

This is a stunt well worth remembering because it is usually the last hacksaw that breaks the quickest.—S. R. D.



## As if across a desk

"New York is calling!" says the operator in San Francisco. And across an entire continent business is transacted as if across a desk.

Within arm's length of the man with a telephone are 70,000 cities, towns and villages connected by a single system. Without moving from his chair, without loss of time from his affairs, he may travel an open track to any of those places at any time of day or night.

In the private life of the individual the urgent need of instant and personal long distance communication is an emergency that comes infrequently—but it is imperative when it does come. In the business life of the nation it is a constant necessity. Without telephone service as Americans know it, industry and commerce could not operate

on their present scale. Fifty per cent more communications are transmitted by telephone than by mail. This is in spite of the fact that each telephone communication may do the work of several letters.

The pioneers who planned the telephone system realized that the value of a telephone would depend upon the number of other telephones with which it could be connected. They realized that to reach the greatest number of people in the most efficient way a single system and a universal service would be essential.

By enabling a hundred million people to speak to each other at any time and across any distance, the Bell System has added significance to the motto of the nation's founders: "In union there is strength."



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Here's the simplest and most practical Knife Sharpener ever invented. Makes keen edge on any kind of knife. Wonderful Reflector—every home wants—show (1—5 sale is made. Big profits for dealers—easy to make \$2.00 an hour. 250 other fast selling Household Articles. Get the Agency your chance to clean up. Write quick—4-day territory going fast. The American Products Co. 7077 Third St. Cincinnati, O.

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	Standard Change Gear	Quick Change Gear		Standard Change Gear	Quick Change Gear
9"x3' Lathe	\$150.00	\$175.00	18"x8' Lathe	\$385.00	\$435.00
11"x4' Lathe	194.00	212.00	18"x10' Lathe	591.00	648.00
12"x5' Lathe	259.00	301.00	21"x12' Lathe	831.00	965.00
15"x6' Lathe	320.00	367.00	24"x14' Lathe	1129.00	1278.00

Free Catalog No. 76

SOUTH BEND LATHE WORKS, 433 E. Madison St., SOUTH BEND, IND.





"Red Devil" Rapid Boring Auger Bits are 33 1/2% easier to use, bore 10% greater clearance and bore with or against the grain of any wood. Size 1400—10-16 in. diameter bits, 75c.

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Made in every popular style and size for every need. "Red Devil" Snip No. 576, one of the many styles.

### A Handy Household Tool

Whenever you have any rough cutting to do—from rubber washers to sheet iron—you have need for this practical snip. It will enable you to do things for yourself that you would otherwise pay to have done.

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Mechanics' tool booklets free  
"Red Devil" Tools—  
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**SMITH & HEMENWAY CO., Inc.**

Manufacturers of "Red Devil" Tools  
264 Broadway New York, N. Y.

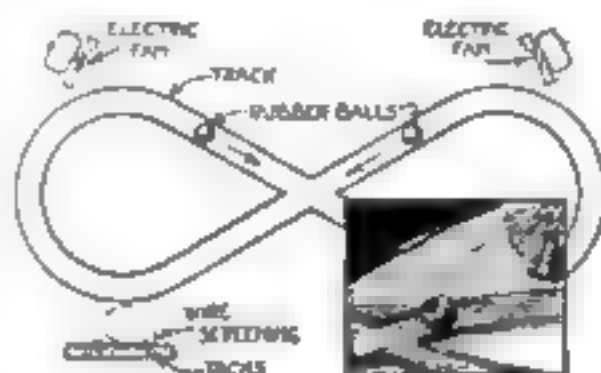
"Red Devil" Glass Cutters—the plastic standard tool of the world. "It's all in the wheel." Made in 40 sizes. No. 24 shown below.

### THE HOME WORKSHOP

#### Perpetual Motion Rubber Balls Form Store Window Novelty

A WINDOW display feature that is guaranteed to attract a crowd consists of two concealed electric fans, two rubber balls and some wire window screening.

The screen wire is cut to form a figure eight track for the balls, strips of screening about 2 in. high being used to form a



In use, the fans are concealed by the window decorations.

fence for inclosing the track. The fence is erected directly on the floor of the window and may simply be tacked in place if a 3/4-in. edge is turned at right angles.

The blast of air from the two fans keeps the balls moving at good speed, and the fact that they occasionally collide at the intersection only adds to the interest of the display. In dressing the window, it is an easy matter to conceal the fans so that the source of motion remains a mystery. There is no way of guessing that their motive power is air, as long as there is nothing in the window that can be swayed by the air currents.—H. F. B.

#### Rubber Puttees for Hunters

THE hunter who wades through wet grass for two or three hours with his trousers legs and feet wet is apt to awake the next morning with stiff limbs. Rubber boots prevent this, but they are heavy to hunt in and hurt the feet.

One of the best ways to keep dry is to use spiral rubber puttees. These are made by cutting around and around old automobile inner tubes in spiral fashion. A good width for the strips is 2 in.

The upper end of the rubber is simply tucked under to keep the puttees in position.—R. E. DEERING.



Strip of old inner tube wound on spirally.

#### Making a Knife for Light Work

FOR light work, such as stripping insulation from wires, a handy little knife can be made from a piece of broken hacksaw blade about 5 in. long. Wrap two or three inches at one end with friction tape to form a handle and grind the back of the remainder to a knife edge. The saw teeth can be used also for sawing in places where a hacksaw frame would be in the way. ALLEN P. CHILD.



Utilizing broken hacksaw blade.

## Save money on Radio parts

### RHEOSTAT

Built for hard usage. Sturdy in construction, electrically efficient and handsome in appearance.

RHEOSTAT with DIAL \$1.30  
with POINTER \$1.10



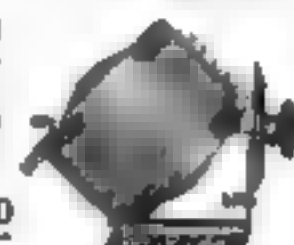
### VARIOMETER

Beautifully designed of hard rubber and nickel-plated steel. Hard rubber Rotor and Stator Shape of Stator

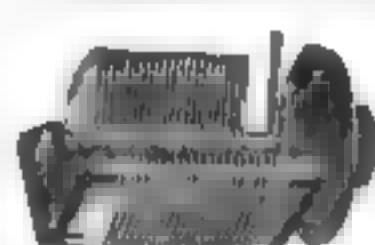
conforms with Rotor, using minimum space on panel board... \$5.00

### VARIO-COUPLER

Fiber tubing, hard rubber Rotor nickel-plated hardware. Best grade of green covered copper wire. Large size has 180 degree adjustment. \$4.50



### VARIABLE CONDENSER



Nickel plated hardware. Aluminum plates. No loose parts. Plates stay in alignment, giving maximum efficiency. 23 plate type has capacity of .0005 M. P.; 43 plate, .001 M. P.

23 plate condenser \$3.50  
43 plate condenser \$4.50

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Volts 60 cycle  
5 speed  
complete with  
N.Y. 400 and  
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1/2 H.P. 10  
Volts 60 cycle  
5 speed  
complete with  
N.Y. 400 and  
cranked pulley  
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Volts 60 cycle  
5 speed  
complete with  
N.Y. 400 and  
cranked pulley  
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It sees that you get more mileage for your money—by recording the miles your truck travels, as against its traveling expenses.

It lets no leaks in truck management or use of supplies go unchecked, but reports the service-miles per gallon of gasoline, per pint of oil, per battery-renewal, per tire-life, per dollar of repair cost.

Whatever it costs now to operate your truck, it will cost you less when you get an accounting from the

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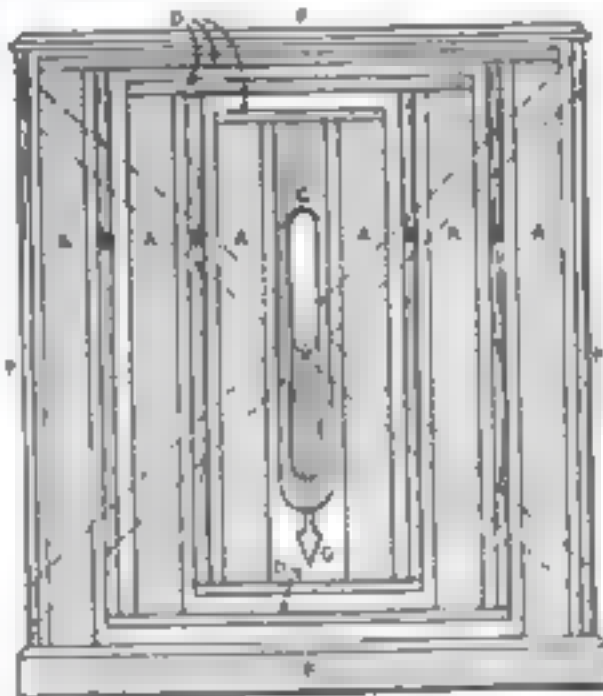
## THE HOME WORKSHOP

### Wooden Hygroscope Foretells Wet and Dry Weather

THOSE who are handy with tools and take pleasure in doing neat, accurate woodwork will find the making of this wooden hygroscope an interesting problem. The finished instrument makes a fine looking piece of scientific apparatus and is most interesting to watch in action. It should be noted that while the hygroscope is scientific in so far as it will indicate the weather to be expected, it should not be called a hygrometer, as that instrument registers the percentage of moisture in the air.

Although no particular measurements are specified, since the maker can use his own judgment, 8 by 10 in. is a good size. To preserve the general proportions, the depth from front to back of the uprights, A and B, should be about one half greater than the width. The outside framework, F, should be a trifle deeper, and the base, E, considerably more so.

The columns, A, are of any clear, straight-grained, soft wood, sawn across the grain. Each pair should be from one piece of wood, sawed in half, so that the grain of each will be similar. The connect-



Moisture in the air causes strips marked A to swell, and their expansion is added together and communicated through strips B, C and D, and rack and pinion to the pointer G.



ing pieces, B, D, and C, are of hard wood, with the grain lengthwise. The outer columns, A, are first fastened to the base; the top cross bar, D, is then glued and screwed to their upper end; the descending bars, B, are fixed to this, and so on until C is reached, as shown.

Connecting piece C should have a slot down the center, on the inside of which is fastened a rack engaging the teeth of a small cog-wheel. This cog is attached to a spindle, on which is fixed the pointer, G. Most workshop junk boxes or attic chests contain the works of an old clock from which the pointer and gear can be taken. The rack can be filed from a strip of brass and fastened on with screws.

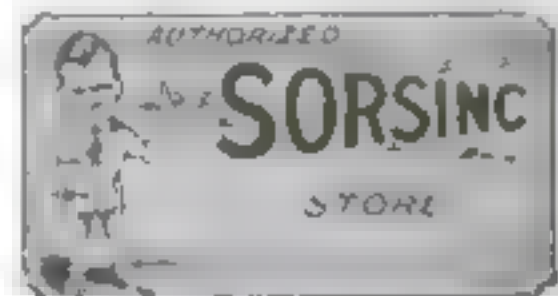
Two diagonal braces, represented by dotted lines in the accompanying drawing, may be added to the framework to keep the outside columns in line and to steady the pointer spindle.

The face may be of either wood or metal,  
(Continued on page 101)

## MURDOCK RADIO

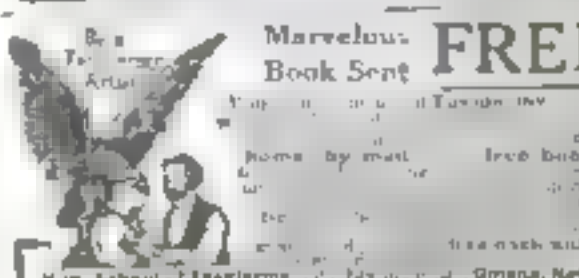
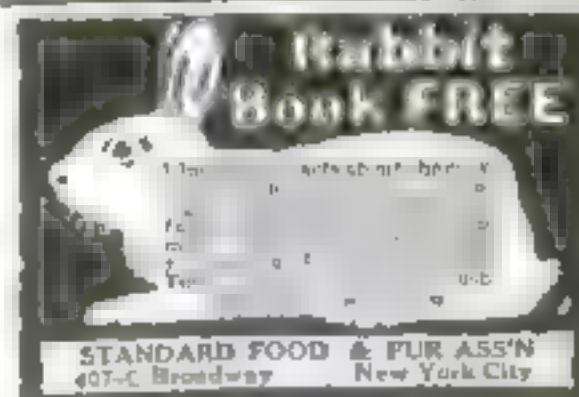


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When you see this sign in the window of a radio shop You May Enter—assured that the apparatus and prices are right, the stock complete; a competent radio expert in charge,—and the Golden Rule in force.

It Pays to Buy at the Sorsinc Store





THE HOME WORKSHOP

Wooden Hygroscope Foretells Weather

(Continued from page 100)

solid, or, perhaps better, made with fret-work or flugree work. The one illustrated is cut from sheet brass and fastened to the framework. The large circle is marked with degrees so that a record of the readings may be kept.

The principle on which the instrument works is this: Moist atmosphere will cause wood to expand more across the grain than with it, and this swelling in the columns marked A is communicated through the strips B and D, to C, which, in rising, turns the pointer. The reverse action takes place when dry weather causes the wood to contract again. The movement is in proportion to the sum of the expansion of all three pairs of columns.

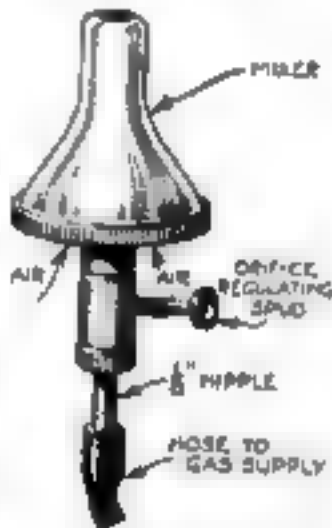
As wood absorbs moisture more readily than it discharges it, the instrument seems to give more and longer notice of southerly winds and rain than northerly ones to dry weather. Thus, a small swing of the hand toward "dry" will mean more than an equivalent movement toward "wet." Neither the cross bars at the back nor the face must touch the columns, which should be entirely free in every direction except where the first bar is joined to the base.

Different colored wood may be used and any part of the apparatus painted or varnished as desired, except the columns A, which must not be treated in any way.

Blowpipe and Soldering-Torch Made from Gas-Light Burner

WHEN I was about to undertake a certain repair job recently, I found that I had forgotten to include an alcohol blowpipe in the toolkit. In its place I used an air mixer and orifice-regulating spud of an ordinary inverted gas-mantle burner. This I attached to a gas outlet by means of a hose, and it gave a better soldering-flame than the alcohol lamp, much to our surprise.

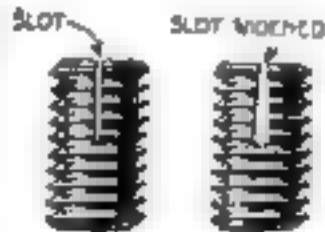
This torch or blowpipe is now in daily use and the alcohol torch is reserved for places where no gas connection is obtainable.—JOHN H. SCHALEK



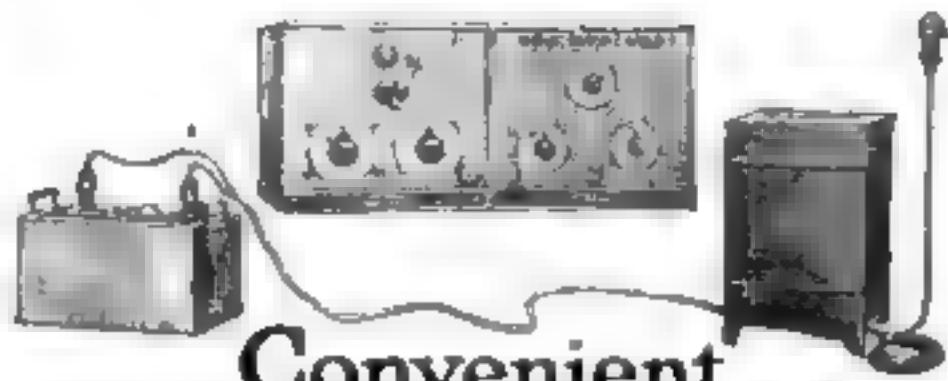
Provides hot flame

Hacksaw Slot Takes Place of Cotterpin Hole

IT IS not always easy to drill a cotterpin hole in a small bolt. A substitute method that works very well is to cut with a hacksaw a slot down to where the cotterpin will come. Then slightly saw down the sides of the slot in an inverted V shape. If necessary, the end of the bolt may be pinched. This scheme will work well on bolts as small as 1/4 in.—E. MILLER



Easier than drilling



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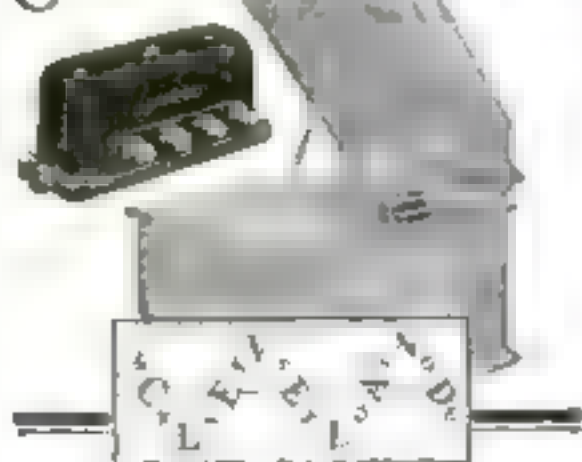
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### How to Keep Warm on 30% Less Coal

(Continued from page 32)

our houses, offices, schools, and workshops.

The first step in remedying this condition in your houses, with a view to saving on the fuel bill, as well as improving comfort and health, is to purchase a hygrometer, an instrument to register relative humidity. There are two general types of this instrument. The more accurate type has two thermometers, the bulb of one being inclosed in a water saturated wick. The difference in degrees registered by the two thermometers when compared with an accompanying scale, shows the humidity. The other type is direct reading and operates by the contraction or expansion of a hair under the influence of moisture in the air. One of these instruments will cost five dollars or more, but it should be regarded as a necessary bit of household equipment.

The next step is to devise some method for supplying humidity to the air. A great deal more water is needed for this purpose than is usually supposed. The usual warm air furnace has a water pan in the bottom holding a gallon or so of water, and occasionally some one remembers to fill the pan. But for all the good it does, it might as well be forgotten. A pan of this sort actually supplies less moisture to the air than a human body gives off in a day, and affects the humidity of the house scarcely at all. In order to maintain a humidity of about 50 per cent at 70 degrees in the average seven- or eight-room house, we must evaporate into the air from 17 to 20 gallons of water a day.

#### Humidifier in Furnace Fire Pot

The best of the modern hot air furnaces has a cast iron evaporating pan on top of the fire pot, inside the furnace shell. This pan is connected by pipe with a tank on the outside of the furnace in which the water level is the same as in the pan inside. A water valve controlled by a float, of the type used in toilet tanks, keeps the tank constantly filled with water. In making such an installation, equip the outside tank with an overflow pipe, so that if the float valve fails to operate, the furnace will not be flooded inside.

A number of types of humidifiers now on the market may be attached to steam or hot water radiators, but careful tests have shown these to have little or no value. The problem of humidity is most easily solved in a steam system, for which there can be purchased a small noiseless and adjustable valve that allows some of the steam to escape directly into the air of the room. For the hot water heating system no simple method of obtaining the desired humidity has been suggested.

The following instructions may be safely followed in the operation of any system of heating, and may be profitably applied by any householder:

1. A good draft is essential to proper combustion. Therefore, the chimney should be absolutely tight and the smoke connection as short and straight as possible.
2. A hand damper should be installed in the smoke pipe to regulate the intensity of the draft. This should be installed in addition to any other mechanically operated dampers that may be in use.
3. The heater base should be tight and grouted to the floor to prevent air leakage.

(Continued on page 103)

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Keeps home warm.  
Three times the heat.  
Does away with coal  
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## THE HOME WORKSHOP

## Toy Steam Engine Propels Small Model Side Wheeler

A UNIQUE use for the small toy steam engine is to install it as the power plant of a model side-wheeler steamboat.

The boat should be flat-bottomed and comparatively wide. One good way to make it is by constructing a wooden frame and covering it with tar paper, as described on page 74 of the September POPULAR SCIENCE MONTHLY. Another way is to build it entirely of wood. In that case, the bottom, stern posts, bow stem, and the two braces, all of which can be seen in the accompanying photograph, are cut from a



A steamboat so simple in construction that any boy can build it

1/4-in. board. The two sides are made from thinner wood, the sides of a cheese box being especially suitable.

While cutting the bottom, place the two thin sides in a tub of water so that they may become thoroughly saturated. See that the base is wide enough to accommodate the engine. The front and bow are then attached to the bottom, and the two side pieces, now being pliable, are bent to the shape of the frame and tacked on. After they are attached, saw off the surplus wood.

Two holes are bored in the sides of the vessel to suit the shaft, which is simply a piece of stout wire. It should be about 2 in. longer than the width of the boat. To this shaft is fastened firmly a pulley, the size of which will depend upon the engine. It must be large enough so that it will turn not more than once for every ten revolutions of the flywheel. The larger the pulley, the better the engine is apt to work.

At each end is attached a disk of wood to form the hub for the paddles. These are made from odd pieces of tin or an old tin can. First cut a circle, divide it into 8 parts, and then cut out the six paddles. They are attached to the wooden disks, as shown. Care must be taken to see that the paddles do not go too deeply into the water. The best results will be obtained if they do not enter the water more than 1/4 in.

A mast can be attached, if desired, and a superstructure or other details added to suit the maker. All that then needs to be done is to paint the boat with a good white lead paint.—E. H.

## Resurfacing Worn Oilstones

THE method of resurfacing worn oilstones, used by most toolmakers, is to sprinkle some coarse emery on a flat metal surface, such as a bench plate, and rub or slide the oilstone over it until it is reconditioned. This leaves the stone perfectly flat and gives it a cutting quality equal to new.—H. P. BOETTCHER.

## Super-Antenna

Saves Cost of Aerial  
Attach to Any Light Socket

The "Super-Antenna" unit has been designed by one of the country's foremost engineers for Radio Reception over electric lighting circuits.

You can now pick up broadcasted concerts in any room or at the home of a friend by simply attaching the "Super-Antenna" plug to any electric light socket.

The "Super-Antenna" does away with the overhead aerial and the dangers of stringing wires. Eliminates expense of switches and lightning arresters. Safeguards your Set—Will not blow fuses and is absolutely shock proof. Operates on any electrical circuit from 32 to 120 volts, D.C. or A.C. and does away with alternating current hum. Does not use current. Switch can be turned "ON" or "OFF."

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The "Super-Antenna" unit in voltage, weight and design is made to conform with the requirements of the National Board of Underwriters and has been tested and approved by leading electrical experimental stations.

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On account of the heavy demand, we suggest you order at once. If your dealer cannot supply you send check or money order direct giving us your dealer's name. PRICE **\$2.80**

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## F. R. L. Super-Receiver-Radio Frequency

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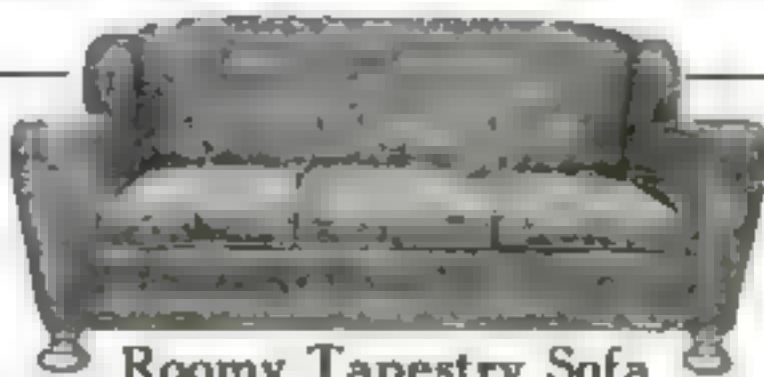
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## THE HOME WORKSHOP

## Railroad Iron Makes Small Anvil

A LIGHT anvil suitable for small work is frequently useful in the home workshop, and one can be made without much trouble from a piece of heavy railroad iron.

The one illustrated was roughed out on a power hacksaw and finished by hand on an emery grinder, the top being planed off to make a flat working surface. It is screwed to a heavy wooden plank, to the bottom of which is fastened a cleat. This permits the anvil to be set up in the bench vise at a moment's notice.



Anvil with vice attached

The usefulness of the anvil shown was extended by welding to it a small hand vise that extends a little above the top surface.

A piece of 60-pound rail was used for the anvil, which is 12 in. long, stands 4 in. high above the base block and weighs 12 pounds.—P. M. W., Jr.

## How to Make a Cool Smoking Short-Stemmed Pipe

ALL pipe smokers know that a long-stemmed pipe gives a cool smoke but is awkward to carry and is undesirably conspicuous. A short-stemmed pipe can, however, be altered with little difficulty to give the same coolness.

Select a pipe with a straight stem and a very short mouthpiece. Remove the



mouthpiece and drill a hole into the stem and bowl that will take a piece of aluminum rod. Have the rod threaded throughout its length and tapped at one end to suit the mouthpiece. Cut it off short enough to allow the mouthpiece to come flush with the stem. The smoke will then be forced to travel around the thread before it enters the mouthpiece.—EDWARD G. GETTINS.

## Fan Improves Carpet Beater

TO DRIVE away the dust while beating rugs and prevent it from rising in my face, I fastened a fan to the handle of the carpet beater by means of an open coil spring about 3 in. long, made from No. 12 gage wire. For making a hole in the handle, I used a wire nail, the point of which was hammered to a chisel edge so that it would not split the wood.

The handle of a palm-leaf fan was tapered a trifle and notched roughly so that it could be screwed into the spring far enough to hold firmly.—G. M. BEERBOWER.



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are greatly increased by the use of first class apparatus. Convenience in operation—excellence in results, are characteristics of equipment fitted with

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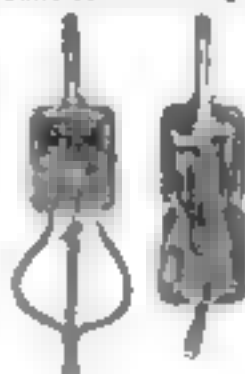
Standard for high efficiency in commercial and amateur service.

STROMBERG-CARLSON "Radio Head Sets" are designed especially for comfort and adjustability, with tonal qualities unexcelled in reproducing accurately faint long distance signals. In addition, the construction permits the separation of the receivers so that two observers may "listen in" simultaneously.

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## Voices Across the Atlantic

(Continued from page 64)

readers of POPULAR SCIENCE MONTHLY to learn that much of the preliminary work has already been done at Radio Central, the gigantic radio station at Riverhead, L. I. This station, when completed, will be the most powerful in the world, and will be able to carry on direct communication with almost all parts of the world.

Undoubtedly it will be one of the first to establish continuous transatlantic telephony. The preliminary work that has already been carried on there has been done by two separate corporations in co-operation with the Radio Corporation of America. One of these two companies has been experimenting with power vacuum tubes of 20 kilowatts output each, and the other with tubes of 10 kilowatts, both using tubes in parallel to build up the desired amount of radiation energy.

I am reliably informed that an antenna energy of 25 kilowatts has already been obtained in the antenna system at Radio Central from the bank of 20 kilowatt tubes.

## The Radio "Flivver"

HAVE we got the "silver of radio" in the single-tube Armstrong super-regenerative circuit?

In my opinion we have, and with this opinion E. H. Armstrong agrees. He stated it specifically when he gave a demonstration before the Radio Club of America at Columbia University recently.

At the conclusion of the demonstration, Armstrong said that one of the possible developments of the single tube circuit would be to have the tube perform the functions of regenerator and oscillator, and then have a rugged crystal, permanently fixed, operate as the detector.

In this way a set could be constructed with a standard loop aerial, and set permanently at 860-meter wave length adjustment, so that all the radio fan would have to do would be to press a button and turn the loop toward the broadcasting station.

The crystal in this case could be carborundum, and it could be permanently set, because of the tremendous amount of energy that would be supplied to it by the super-regenerator. A single stage of audio-frequency amplification, also permanently adjusted, would then give loudspeaking results. This idea is perfectly feasible.

## Government Radio

(Continued from page 67)

conditions; and this means high power—much higher power than is used at present. In Europe it has been demonstrated that powers of one kilowatt and upward must be used to insure successful transmission over a distance of 100 miles or a little more. In this country, 15-watt sets have been heard 1000 miles, of course, but this is 'freak' reception.

"These are some of the reasons why I believe government broadcasting will be the only finally successful plan."

It is an almost staggering vision of public service that Mr. Howell sees as the ultimate goal of broadcasting. And if he is elected to the Senate this fall, we shall have one real radio man in Congress, and one who frankly states that he will put up a fight for the great government broadcasting system in which he believes.



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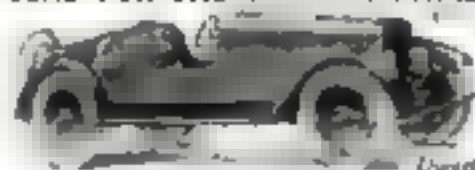
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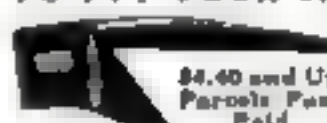
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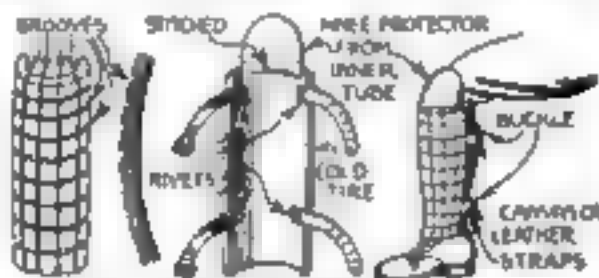
**American Code, Inc.**  
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## THE HOME WORKSHOP

### Football Shinguards Made from Old Automobile Tires

**T**HIS idea grew out of an emergency. Before a football game a number of players were shy of shin protectors and the cost of buying them was so great that I tried out the possibility of making guards from old automobile tires.

In order to have them as pliable as possible, I cut V-shaped slots  $\frac{3}{4}$  in. apart on



Combines strength with considerable flexibility

the face of the tire. The straps were made of 14-oz. canvas doubled and sewn, although leather straps would have made an even better job. Small iron buckles were used for fastening the straps.

The knee protectors were cut from an inner tube and given an outside covering of canvas, which was reinforced with No. 20 wire stitched around the edge and vertically.—GEORGE R. AUGER

### Blowing Up a Football

**E**VERY boy who has tried to blow up a football or basketball knows the need of a special fitting for making the connection. A fitting that will serve the purpose can be made in 10 minutes with a file.

Obtain a valve stem from any discarded automobile tube; saw or file off the base or part that attaches to the stem of the tube, and then file the same end of the stem to the tapering shape shown in the illustration. The two grooves



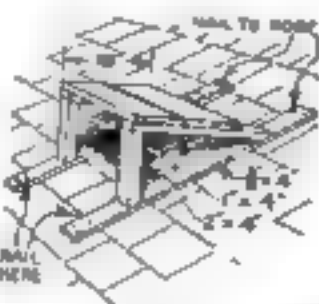
Attachment made from valve stem

are not absolutely necessary, but help to prevent the rubber tube from slipping off the valve.

Screw the threaded end into the air-pump connection, push the tapered end into the tube of the football bladder and then pump. The check valve in the stem prevents the air from escaping, and leaves both hands free to double over the tube and tie it.—L. C. MACDONALD

### Bracket Staging for Roof

**T**HIS roofing bracket is supported on two  $\frac{3}{4}$ -in. pieces. The uprights are 2 in. by 4 in. and are nailed to the thinner boards from underneath; they can also be toenailed, if it is thought necessary. The nails



Supports roofing scaffold

used are round-headed and their holding power is exceptional. The cross piece may be 1 by 4 in. or 2 by 4 in. The width of the complete staging is 18 in.

The upper and lower ends of the  $\frac{3}{4}$ -in. pieces are lashed to the roof. One pair of the brackets support the scaffold boards and another pair should be handy so that they can be put in place higher up before the first pair is removed.—R. P. L.



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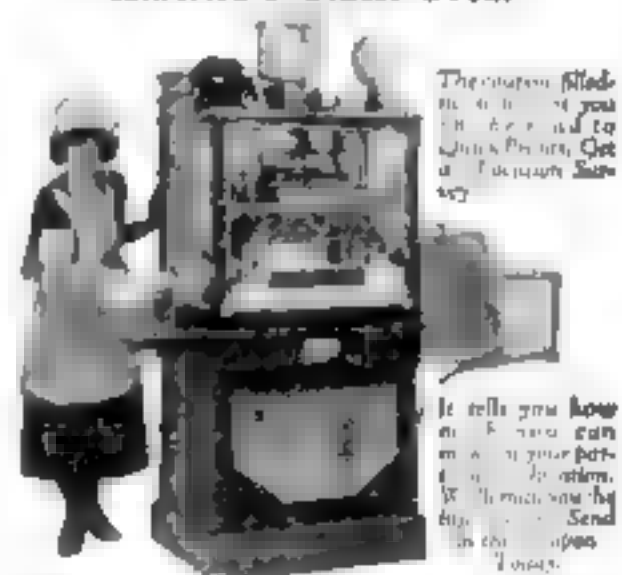
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## THE HOME WORKSHOP

### Making Clear Leaf Prints with Carbon Paper

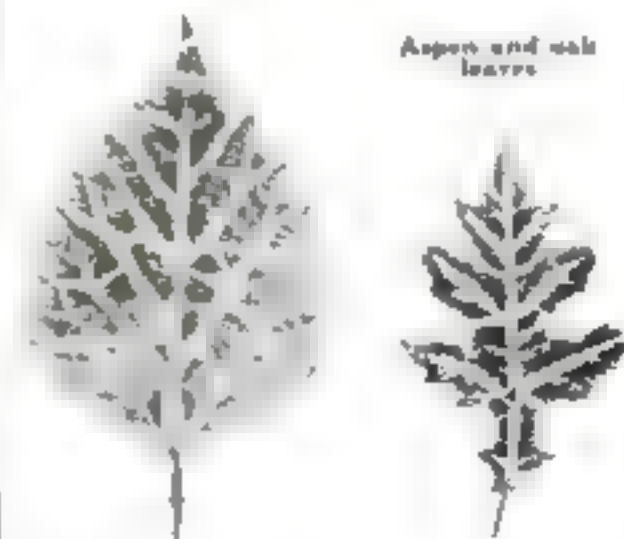
**I**N STUDYING botany, it is necessary to make permanent records of the form of various leaves. To do this by means of freehand drawing requires considerable skill and patience. Prints taken directly from the leaves are easier to make and contain more detail. No elaborate apparatus is necessary, because the printing can



be done with ordinary typewriter carbon paper.

When perfect specimens of the desired leaves have been obtained, place one of them on a sheet of paper, resting on some soft surface such as a magazine covered with a piece of cloth. Next, lay a piece of carbon paper on the leaf, carbon side down. Place another piece of paper over it and press down heavily with a gas or electric iron, heated but slightly. Move the iron back and forth gently a few times. In a minute or two sufficient ink from the carbon will have been transferred to the leaf so that it can be used to make a direct print.

Now take a good grade of paper or bristol board and lay it on the cloth-covered magazine. Place the leaf in position upside



down upon the paper and press it down with the warm iron. This will transfer a positive print of the leaf to the paper and will show clearly the edges, serrations, and venations.—B. E.

### Making Putty that Will Stick

**A** PUTTY that is said to stick like glue in a nail hole or crack may be made by mixing together two or three handfuls of plaster of Paris and a little paint, preferably of the color to be used on the woodwork. Knead these up like putty, adding more plaster if the mixture is sticky. This sets quickly and becomes very hard.—R. L.



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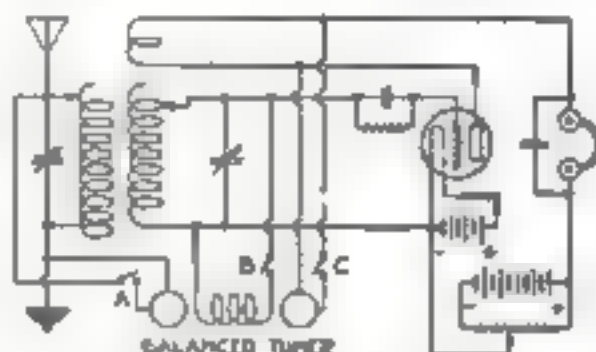
### THE HOME WORKSHOP

## Ford Panel Switch Permits Quick Change of Radio Circuits

By J. M. Rolston

IN CHANGING from short to long wave reception I make the necessary circuit adjustments in my radio set quickly and easily by using a Ford panel switch. This permits me to use a variocoupler type of tuner for broadcasting, and various sizes of honeycomb coils for the long wave stations. The accompanying diagram shows how the circuits are arranged.

For the short wave balanced tuner I use honeycomb coils Nos. 25, 35, and 50. The wiring from the No. 35 coil was removed



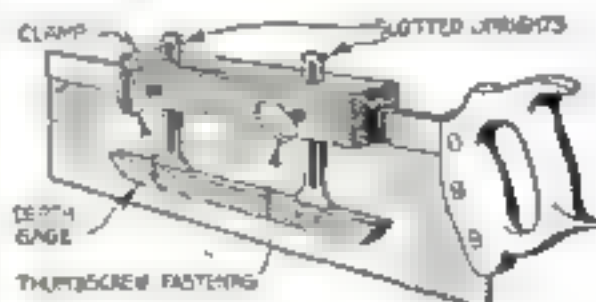
A combination long and short wave set

and wound around a composition tube 3 in. in outside diameter and 3 in. long, which forms the secondary. (This could have been accomplished more cheaply by winding on a corresponding amount of magnet wire instead of using that taken from a purchased coil.) Inside the tube I mounted a No. 25 coil to form the primary and a No. 50 coil to form the tickler, the connections being made by means of brass brushes bearing against collector rings mounted on the coil shafts.

The hook-up is so arranged that a Ford panel switch button (A, B, and C) is in series with each of the tuner coils, they can be cut in at will. When this tuner is in service for broadcasting, no honeycomb coils are plugged in the regular honeycomb coil mounting on the outside of the panel; but for long wave reception the balanced tuner is cut out by means of the push-buttons and the necessary honeycomb coils are placed in the outside mountings.

### Depth Gage for Backsaw

OF MANY types of depth gages for backsaws, one of the most convenient and one that can easily be constructed by



Adjustable gage prevents cutting too deep

the home worker from strips of hard wood, is that illustrated.

The clamp is slotted to fit over the back of the saw. The slot is recessed at two places to take 1/2-in. square nuts, which do not turn but serve as bearings for the two thumbscrews. These engage the slotted uprights, to which is fastened the depth gage proper.

Not only can the gage be raised up and down instantly, but it can be removed when not needed.—JOHN M. PIPP.

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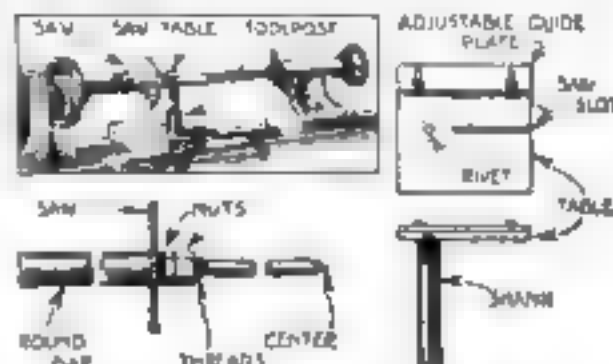
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### Attachment for Light Sawing on a Bench Lathe

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How the attachment is made and used

which is fastened to it with two hexagonal nuts, as shown. The table is riveted to a shank and that is held by a setcrew in the toolpost. Slots are provided for adjusting the guide plate.—FRANK HARAZIM

### Made \$456 in a Month Digging Wild Horseradish

By C. O. Soote, North Salem, Ind.

(Submitted in the contest, "How I Made Money with My Tools")

MAKING a neat little extra income by digging wild horseradish may hardly qualify under the terms of the contest, "How I Made Money with Tools," especially since the tools I used were only a spade, grubbing hoe, and hatchet. But the idea itself is perhaps novel enough to interest readers of POPULAR SCIENCE MONTHLY. My scheme can be worked profitably seven months of the year, although October proved my banner month.

Hiring a man to drive me through the rural districts in his car, I would stop at every house and inquire if there was any volunteer (or wild) horseradish in the neighborhood that needed to be dug up and killed. About one farmer in ten has a field partly covered with it and it seems that every person knows of a patch if he has none on his place. I would find the patch and then make a deal with the owner. Sometimes I would get paid by him for digging it; on other occasions I would have to pay the owner and then again he would say: "Dig it and take it." The result was about the same in the end, for I was selling it for eight cents a pound at various canning factories. When I found a large patch, sometimes a ton in one place, I would hire two men to help dig. When three of us were digging, we could sack anywhere from eleven to fifteen hundred pounds of horseradish a day.

I have never failed yet to make a good day's wages when I have worked at it. The work itself is very simple, for any one can set the spade back three or four inches from the top of the root, push the spade down as far as it will go, then pry up. The root breaks off, but you have the larger part. Cut the green tops off with a hatchet, sack the roots without washing them, and they are ready for shipment.

My best month I dug and sold, with the help of one man, 6700 lbs. at eight cents a pound, or \$456 worth. Most of the canning factories and commission men will buy the horseradish and are glad to get it.



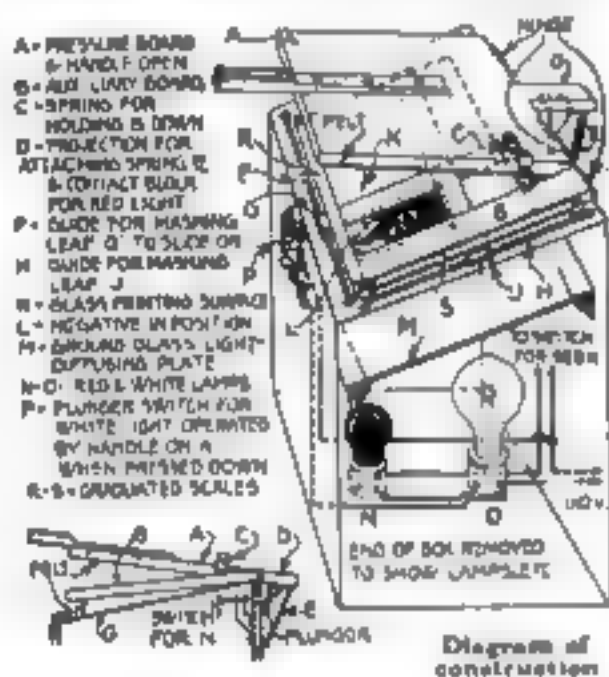
## THE HOME WORKSHOP

Printing Box for Photographers  
Works almost Automatically

By Herbert C. McKay

**PRACTICALLY** an automatic system of printing for the amateur photographer is provided by this printing box. Among its advantages are an automatic light switch, positive contact with even the smallest prints without danger of slipping, printing surface at a convenient angle, easily adjusted masking leaves, and fixed registering guide.

The important points of construction are lettered for clearness. The contact plungers may be purchased at any electrical store, or old fashioned window bolts may be used. For a white light a nitrogen bulb with concentrated filament is best. If two bulbs instead of one large bulb are used, they should be placed so that both are the same distance from the back board. The most important point is to see that the filaments are equally distant from both the front and



the rear of the printing surface so as to give the same effect as a centrally located light would give with a flat printing surface. Any other arrangement will cause uneven illumination of the prints.

The spiral spring *E* attaches to a rear projection of the pressure board and tends to hold it open. A flat spring *C* operates the auxiliary pressure board *B*, which descends and grips the film and paper, holding them correctly registered, while the main pressure board is still 1 or 2 in. above the paper. This allows the fingers to be withdrawn without danger of the film and paper slipping.

The vertical masking leaf *G*, made of thin metal, slides on the guide *F*. The horizontal masking leaf *J* slides on its guide *H*. At the lower left-hand corner the registering guide, which is a sheet metal angle, is set back 3, 16 in. from the printing opening so as to make a permanent 3 16-in. mask. The movable leaves are adjusted to fit the particular negative in hand.

When the pressure board is up and the printing surface exposed, the red light is on. The film and paper are adjusted on the glass over the registering guides and masking leaves and held in place while the handle of the pressure board is pressed. When the board is closed, the red lamp is automatically turned off, and the white light, operated by the plunger switch in front, goes on. The light, diffusing evenly through the ground glass *M*, which makes the print, remains on until the pressure board is raised.

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## THE HOME WORKSHOP

### Wireless Code Transmitter

(Continued from page 74)

by a tension arrangement to keep the film drawn taut. This tension is provided by means of a central washer made from the metal end of an old film spool and part of an old watch spring. This carrier is about on a level with the receiving spool, No. 4, Fig. 3. The receiving spool is a 1/4-in. brass tube, the same width as the film, with brass disks for end pieces. The outer one is fastened with a thumb screw. The inner one is soldered fast to the other end of the tube and is provided with a hole that permits of its being forced on the long clock spindle that carries the minute hand.

### Carpet Binding Makes the Contacts

The two contact pieces, Nos. 5 and 6, Figs. 1 and 2, are pieces of brass bent into U shape. They were actually cut from a section of old carpet binding. Number 5 is soldered at one end to an L piece of brass that is screwed to the baseboard; No. 6 is soldered to a brass hinge of such a length that the two pieces, Nos. 5 and 6, will be on the same level. This permits No. 6 to be moved forward or backward so that the contact piece No. 12 can be made to engage the film. The two rounded edges of Nos. 5 and 6 will face each other.

It will be seen from Fig. 1, that the film is threaded from the carrier, No. 3, beneath the spool marked No. 4 (marked in Fig. 2), up between the contact pieces, Nos. 5 and 6, to spool No. 4, where it is wound. Number 7, Fig. 2, is a metal plug that makes contact through the board and when removed disconnects the receiving part at such times as the sending key, No. 1, Fig. 2, is being used.

Number 13, Fig. 2, is the winding key. Number 11 is the brake to start and stop the motor. It is made of 1/4-in. spring brass pivoted about 1 in. from the end. This short end is bent in to make contact with one of the wheels as the long end is raised or lowered. Number 12, Fig. 3, is a piece of heavy brass 1/4 in. wide, bent U shape so that it will slip over the edge of No. 6. To one end of it is soldered a piece of flattened brass wire, at the free end of which is pivoted a thin brass wheel about 1/2 in. in diameter. It is this wheel that drops into the holes in the film as the film is drawn under it, thus making contact with No. 5. The U piece, No. 12, is provided with a set screw to hold it in place.

### Alarm Clock Winds the Film

The motor power is supplied by an old alarm clock movement, No. 2, Fig. 2. The alarm mechanism, balance fork, and escapement wheel are removed and a fan, No. 8 supplied to regulate the speed. This fan may be brass or wood; it is geared to the wheel that meshes with the escape pinion. To make a record on the film, a punch, No. 15, Fig. 3, and a spacing wheel, No. 16, which can be obtained for 10 or 15 cents each, are used. The punch was altered so that it makes a rectangular hole, the thickness of which is equal to the space between teeth on the spacing wheel. In recording a dash 3 holes are punched together. One hole represents a dot.

Before beginning to punch a length of film, the film should be stretched out on a board, and by means of the straight edge

(Continued on page 115)

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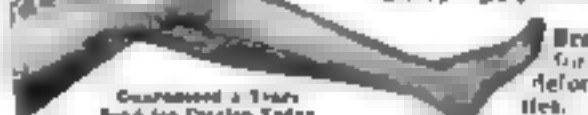
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## The Shipshape Home

### How to Do the Odd Jobs

### Marking Screens

WHEN window and porch screens are taken down in the fall, they should be marked in some way so that they

can be readily replaced the following season. There are a number of good methods for accomplishing this.

One way is to punch marks on the top or the bottom edge of each screen with a screwdriver or chisel, following a uniform system throughout. For instance, the windows are numbered from left to right on each side of the house, so that a frame marked I-I-III would mean the screen belonging to the third window on the first floor front, the first number representing the front of the house, the second the floor, and the third the window. To guard against any possibility of forgetting the combination it is well to mark some of the window frames to correspond and these marks will readily provide the key for the whole system of marking.

Another way is to make a fine line with bright colored oil paint across one side of the top of the frame and the window into which it fits, varying the colors and the combination of lines. These marks will not be obtrusive, but they will, nevertheless, make it easy to replace the screens.

Still another way is to tie together the screens for each room and label each bundle with a stout tag.—L. R.

### Mixing Oil Stains

WHEN a small quantity of stain is needed for

woodwork around the house, it can often be made quite satisfactorily at very small cost with boiled oil, turpentine, and powdered colors. A little experimenting will have to be done to get the exact tint required, but it is possible in this way to make an almost unlimited range of tints and shades.

Suppose it is desired to change a light oak flower stand to dark oak to match the trim of the window near which it is to be used. Mix up a little stain composed of boiled oil, raw sienna, and raw umber, thinned with turpentine. The addition of a little raw sienna will give a color that has more red in it. In fact, with these three colors, which are very cheap, almost any variety of brown and reddish brown may be obtained. M. R. O.

### Covering Steampipes

It is not difficult to refinish the asbestos covering on steam pipes so that it will be as good as new. First

remove the old covering from the pipes by scraping and peeling off with a sharp knife. Then sand the pipes with fine sand paper until the surface is smooth. A convenient length for the sanding is 10 ft.

Then cut strips of 6-oz. canvas or unbleached muslin so that the edges will just meet around the pipe. With an upholstery needle or a darning needle that has been heated and bent and ordinary white string sew the edges together. Give the covering a good coating of cold water paint. ALBERT S. RIEHL.



This One



F6KD-L18-LH2L







## THE HOME WORKSHOP

## The Shipshape Home

Hanging  
Wallpaper

The task of hanging wallpaper can be made easier if the few kinks that are given below are used.

As a guide for the newly pasted strip, stick a common tack or pin at the edge of the preceding strip near the bottom. By allowing the thumb of the left hand to serve as a pivot, the paper will swing into place without much trouble. You can then concentrate your attention on matching the pattern, if that is necessary.

After the two edges have come together, press lightly against the paper with the right hand; it can then be smoothed down. In this way the paper will not be damaged by your efforts to shove it into place or by one strip running over another.

Most wrinkles in wallpaper are caused by not letting the paste soak sufficiently into the paper before it is hung. In the corners the paper should be cut, because it will stay fast much better than if it is folded. Do not let the room get too warm until the paper is dry.

To make flour paste, mix 2 lbs. flour, 1 qt. cold water, and 1 oz. alum previously dissolved in hot water, and add to 3/4 gal. boiling water. Continue boiling until the paste is a semi-transparent mucilage.

Preparatory to papering it is well to coat the walls with glue size. If the walls are in very bad condition, put some brown sugar or molasses in the paste. When pasting, brush out the paste well at the edges of the paper.

A bed caster will serve as a roller for pressing the seams and a clothesbrush can be used for smoothing out the paper. If the woodwork is to be painted, let the repapering wait until after that is done.—FRANK R. MOORE.

Opening  
Stuck Sash

DOUBLE-HUNG sash sometimes sticks badly, especially just after a house has been painted.

Often a lower sash can be opened simply by pulling out the sash cords on both sides and letting go of them suddenly. This lets the weights drop and usually jars the sash loose the first time it is tried.—L. W. FARINHOLT, JR.

Harmony in  
Hardware

IN SELECTING hardware for the house or for pieces of home-made furniture, it is well to remember that

certain finishes and styles of hardware harmonize with certain classes of woodwork. The effect of even finely designed hardware can be spoiled by using it in the wrong place.

To harmonize with light, natural finished woodwork such as cypress, maple, oak, use antique brass or copper finish bronze, what is known as statuary bronze, dark green, or black hardware. Darker woods, such as mahogany, walnut, gumwood and dark oak, look best with bronze and dull brass finishes, but they also go well with bright brass finishes. The black and dark green finishes can be used with mission or Flemish oak, but not with the red colored woods. The nickel and silver finishes should be reserved for use with white and light enamels, although brass and dull brass can also be used effectively with them. Glass knobs go well with light finishes.—E. J. H.

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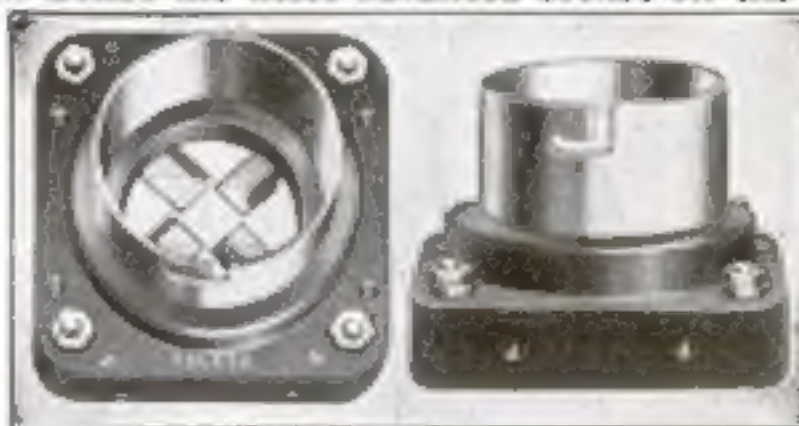
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